THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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THE L.G.B. AND THE ACCOUNTS OF LOCAL AUTHORITIES.

FOR eighteen months past a Departmental Committee of the Local Government Board has had under consideration the Accounts of Local Authorities for the purpose of recommending a complete revision, in order that such accounts may be rendered in a simpler and more intelligible form than those prevailing at the present day. An exhaustive report has been prepared and presented to both Houses of Parliament, dealing with the systems on which the accounts of local authorities in England and Wales are at present kept, and the system upon which they should be kept, together with standard forms of abstracts of accounts for publication.

The arduous work of this Committee calls for the commendation of all local authorities who are anxious to show the financial position of their various departments in its truest form, as the principles of finance enunciated in the report are sound and businesslike. It is our intention in following issues to deal with the whole of the report, inasmuch as it relates to Electricity Undertakings, with the object of placing before engineers and members of committees our conception of the meaning of the various propositions, and of suggesting modifications where we think that such would be beneficial to the undertakings concerned.

We sincerely trust that the report will not be adopted in its entirety, as several matters, particularly the Standard Form of Abstract of Electricity Accounts, require considerable amendment, and we suggest that the Institution of Electrical Engineers, the Incorporated Municipal Electrical Association, and the Associated Municipal Electrical Engineers (Greater London) should take steps to publish commentaries upon the report, and to bring their influence to bear upon their representatives in Parliament in order that the same may have due consideration.

Coincidently with the issue of this report, we published a leading article (July 26th, page 121) dealing with the principle of "income and expenditure" as applied to the repayment of loans, which has an important bearing upon part of the subject matter. The question of "Depreciation" has also met with considerable attention at our hands, and we are glad to notice that prominence is given to this important subject by the L.G.B. Committee. We entirely disagree with the proposition laid down in paragraph 59 of the report, and think that the true solution to the difficulty will be found in our issues of June 21st and 28th, 1907. We also find that several of the subjects recommended by us for consideration by the A.M.E.E. (Greater London) in our issue of August 2nd have been deemed worthy of mention.

We are pleased to note that "accurate cost accounts *must* be kept," for in these words is summed up the foundation of the whole financial fabric. In no other

industrial undertaking are "accurate cost accounts" more necessary than in an electricity undertaking, and their value is far beyond the ken of a L.G.B. Committee. The complex nature of the bases of charges for the supply of energy has rendered it imperative, apart from all principles of accountancy, that accurate and diversified costs must be known and familiar to every central station engineer and manager, and it is welcome news that "accurate cost accounts" in future will be made compulsory. But having issued its mandate, the Committee has stopped there; no indication is given of any system which, by amplification, could become adaptable to the exigencies of individual undertakings—this, of course, would have been beyond the scope of its deliberations; however, the subject comes well within the range of such associations as we have referred to herein and from time to time. We hope to publish in the course of the next few months a system of "Accurate Cost Keeping," which is not based upon theory alone, but has been in actual practice for over three years in a metropolitan borough undertaking, whose low costs and charges testify to the utility of the system.

Reviewing the Report of the L.G.B. Departmental Committee as a whole, the recommendations are admirable, and will have a salutary effect upon municipal electricity undertakings in general, provided that proper Government supervision is enforced; but we fear, unless reform is introduced into the system of audit, that a number of the good principles will never operate. We should like to see, in the near future, Government audit officers specialising the various departments of local authorities. We do not see why a specialist in, say, electricity and dust destructor accounts should not pay an audit visit to each local authority every three months, so that, at the general audit for the year, a vast amount of detail work could be dispensed with, and the recommendation embodied in paragraph 82, relating to prompt posting of the accounts, could be carried into effect. It so happens, at the present time, in the metropolitan area, that the audit of the accounts of the last borough on the roster is barely completed before the commencement of a second new financial year, and as the accounts are not authentic until after audit, any previously published abstract of accounts relating to trading departments is generally subject to considerable alteration, and is, therefore, misleading. It is important that every electricity undertaking should publish annual accounts, duly audited, before the end of June following the close of the financial year, and we trust that the Local Government Board will take steps to carry out the recommendation in paragraph 82.

Sir Philip Magnus on Education.

Although not dealing primarily, or even specifically, with education in science, the address delivered by Sir Philip Magnus, M.P., to the Educational Science Section of the British Association last week at Leicester contains much matter of interest to all persons of scientific training. The title given by Sir Philip to his paper was "The Application of Scientific Methods to Educational Problems." The author began by expressing a doubt whether education had yet reached a stage in which it could be rightfully designated a science—that is to say, if the word science were used to signify any collection of facts and principles so organised as to confer upon the adept a power of prophecy. On the other hand, Sir Philip Magnus held that the methods of scientific inquiry applicable to other branches of knowledge were equally applicable to the elucidation of educational problems. For example, the question of environment in education was one to which too little attention had hitherto been given, for it was incorrect to regard primary education merely as a means of drawing out and strengthening a child's faculties, when, as a fact, it was rather a method of training those faculties to suit the pupil's future relationship to the field, the workshop and the home. Education, indeed, was a "relation," and therefore a system suited to one country was not necessarily suited to another; the systems which were most probably utilisable with profit in this country were such as had been elaborated in the newer British Colonies and countries untrammelled by traditions of the past. Sir Philip Magnus went on to point out the difficulties attaching to the progress of primary education in this country, in view of the fact that secondary education had preceded it by several centuries, so that, to quote a remark made at a recent meeting of the National Education Association, our nation now found itself attempting to draw the democratic horse of primary education by means of the aristocratic cart of secondary. In some respects even there had been a retrogressive movement in primary education. In the old days, when only a limited portion of the population could read or write, and when a careless thinker might have imagined education to be restricted to persons who afterwards became clergymen, physicians and lawyers, the bulk of the populace were actually educated in the hard school of Nature, by experience, and by the invaluable plan of apprenticeship. Nature was the most exacting and merciless of teachers, and the obstacles her pupils had to overcome compelled them to think, the most difficult of all occupations. Since the time when education had been taken out of Nature's hands and placed in those of teachers and boards of education, the descendants of those children who erstwhile were taught in the field, the workshop and the home, were confined within the cloistered seclusion of the modern elementary school; and the spontaneous development of activity which naturally began in earliest infancy was arrested by means of an artificial literary training. Coming more closely into contact with his subject, and almost, it might seem, deigning to attack an article that appeared some time ago in one of our leading reviews, where an author who, we believe, is a gourmet of European repute, ventured to state that cookery was a pure art, hindered in its development by the erroneous notion that it had a scientific basis, Sir Philip Magnus dealt at length with the valuable practical lessons that might be learnt by any intelligent child from practical classes in cooking. The author quoted with marked approbation a letter printed a few weeks ago in the *Morning Post* from the pen of an anonymous teacher, who argued that cookery teaches unforgettable lessons of cleanliness and order, of quickness and deftness in movement, and he very fairly appended the question whether the teaching of grammar, or the analysis of sentences, could provide lessons of equal value in quickening the intelligence of young children.

Speaking of secondary education, Sir Philip Magnus was quite prepared to admit the justice of the word chaos as applied, even by the Board of Education itself, to the development of secondary education in our country, and he added that perhaps the climax of unscientific thinking was reached in the scheme, now happily abandoned, for founding a new university in Dublin on the lines suggested by Mr. Bryce in his famous speech of January last. Even the Inspectors engaged by the Board of Education did not escape Sir Philip Magnus's lash; for he said that until they could be brought to realise that the aim and purpose of practical instruction in primary schools was to train the intelligence through familiar occupations, to show how scientific method might be usefully applied in ordinary pursuits, and how valuable manipulative skill might thus be

incidentally acquired, it did not seem that they themselves had learnt the most elementary principles of their own profession.

Copper.

The easing in the price of copper (anticipated in these notes for April) which is now taking place, though apparently fairly thorough, is characterised by the nervous jerkiness which denotes rather the influence of exchange operations than a substantial result founded on natural trading. The 29th of June saw the price of Standard at £96 10s., by July 15th it had dropped to £94 10s., and the month closed with a drop below £90. Visible supplies at the end of June were 12,298 tons, rising to 12,700 for mid-month, and inclined to increase. Re-shipments to America have dropped steadily since January, into which may be read an indication that the supplies in that country are proving sufficient. On the whole, however, supplies must still be considered decidedly low, and buyers will doubtless proceed with caution for fear of causing another squeeze in the prices. The market anticipations, as evinced by the price for three months (£86) do not forecast difficulty in this direction at present, but until supplies begin to show up on the surface, little confidence can be placed in the permanency of any quotation.

It is somewhat depressing to learn that the mid-month fall was largely due to the reduction in price of electrolytic by two large American producers, as, although this was probably brought about by trade conditions, movements of this kind are capable of delay or revocation calculated to increase the difficulty of the situation for consumers.

The Patents Bill.

The Patents Bill now before Parliament has been amended by the Standing Committee so as to empower the Comptroller, if he is satisfied that the invention claimed has been wholly claimed or described in a prior specification, to refuse to grant a patent.

A memorial objecting to this amendment is, we understand, being extensively signed by scientific and technical men who propose to send a deputation to the President of the Board of Trade.

Judging from a letter published in the *Times* and signed, we presume, by some of the memorialists, it is to be contended that this amendment of the Bill is most dangerous and undesirable in the *public interest*. It would be interesting to know whether that section of the public which is most interested in preventing the granting of invalid patents, namely, the manufacturer who is not a patentee, and the consumer who has to pay the increased price for the patented article, will be represented on the deputation.

The arguments in the letter to the *Times* already referred to, appear to us to ignore completely the public interest, and to advocate rather the granting of illegal monopolies to individuals for inventions which have become public property. We can only suppose that some of the eminent men who have signed the letter have not fully considered the question.

For example, it is said that the Comptroller having power under the present Patents Act to insert references to anticipating cases, "it is, therefore, quite impossible for an applicant to deceive the public as to the novelty of his invention, or to conceal from the public any alleged anticipation. If the invention be really anticipated the applicant's specification will at once condemn his patent, and the grant can do no harm." This evidently does not apply to the patentee who proposes to manufacture his own patent, and wishes to mark his manufactured articles as "patented" for trade purposes. Nor does it apply to the blackmailing or "privateer" patents, which are used to extort royalties. There is evidence that these royalties are often paid to avoid the worry and expense of contesting the matter in the Law Courts. But the signatories to the *Times* letter justify their position by the astounding proposition that "a patent which leads to the introduction of an article not previously on the market conduces to industrial activity and employment of workpeople, and therefore is advantageous to the community, even should the patent subsequently prove to be invalid." The signatories evidently believe in the repeal of the Statute of Monopolies. The question will arise: How is the fortunate individual to be selected who is to receive this gift of public property?

In 1905, 1,308 applications for patents were reported to be wholly anticipated, and patents were granted, at the request of the applicants, on a considerable number of these.

The *Times* letter exaggerates, as is usual in the case of inventors, the risk of a patent for a valuable invention being refused by the Comptroller. Considering that the Comptroller is assisted by a highly trained technical staff, and that there is an appeal from the Comptroller to the Law Officer, the risk, we think, can be taken as negligible. Germany, the United States, and nearly all great industrial countries reserve the power of refusing patents for inventions that are not new, and no irreparable injury has resulted to the industries of these countries.

We hope that Mr. Lloyd-George will remember that the interests of the great mass of the public are not represented by these memorialists, and that he will hesitate before he removes a provision from his Bill which will protect the public from becoming the prey of the privateer patentee.

The New Electrolytic Alkali Works at Niagara Falls.—The main object of an electrolytic cell for the decomposition of alkali chlorides should be to counteract the tendency towards recombination of the caustic alkali formed at the cathode with the chlorine set free at the anode. This recombination must be avoided, not only on account of a loss of efficiency, but also because hypochlorites and chlorates are formed which cause a disintegration of the graphite anode to set in. The following principles may be laid down: The rate of diffusion between analyte and catholyte is a function of the concentration of the diffusing solutions. It is also a function of the time during which the given solutions remain in contact. The caustic alkali formed at the cathode itself takes part in the electrolysis, whereby hydroxylions tend to migrate towards the anode and there act as oxidising agents. For these reasons a gravity cell, working with an acceptable ampere efficiency, gives of necessity weak caustic liquor. It must be borne in mind that a high ampere efficiency is not the only factor to be taken into account in the successful working of a plant. Lack of stability, large cost of maintenance, and high initial cost must be avoided.

The Townsend cell is of the diaphragm type. The anode space is enclosed between two vertical diaphragms, and a non-conducting body having the shape of a wide U. Graphite anodes pass through the lid of the cell and are connected to the generator by means of clamps. The cathodes consist of perforated iron plates in close contact with the diaphragm, and are fastened to two bulging iron sides to form the cathode compartment. The anode space contains brine, while the cathode compartment is filled with kerosene oil. On account of the difference in gravity of the two liquids, there is a hydrostatic pressure from the anode to the cathode compartment, and if the current is turned on, the percolating brine becomes cathode liquor and carries caustic hydrate, the strength being determined by the current density employed. This liquid, however, immediately drops through the perforations of the cathode plates, and sinks rapidly below the oil, and is automatically withdrawn. The rate of percolation can be regulated at will by raising the level in the anode compartment, whereby the strength of the caustic alkali produced can be varied. Such cells as these, 64 in a set, have been continuously in use since the beginning of 1906, each set carrying from 2,000 to 2,300 amperes. New cells, however, are being constructed to carry 4,000 amperes with the extraordinary current density of 1 ampere per sq. in. of anode surface. The cells measure 8 ft. long, 3 ft. high and 1 ft. wide. The non-conducting body is made of cement concrete against which are clamped two iron side plates, bulging in the middle, and provided with flat borders. A rubber gasket enables the making of a tight fit when the side plates are clamped in place. This arrangement makes the cell easy to dismantle and reassemble, which is a distinct advantage. A steady level is maintained in the anode liquor by providing a movable overflow, which in turn controls the hydrostatic pressure between the cells. This cell runs smoothly, and requires little or no attention. There is, of course, a small loss of kerosene, but this does not amount to more than a few shillings a day on a large plant. Both maintenance and initial cost are small, and the ampere-efficiency is about 90 per cent. The diaphragm consists of woven-sheet of asbestos cloth, the pores of which are filled with a mixture of iron oxide, asbestos fibre and colloidal iron hydroxide. This does not become gummy on contact with sodium hydroxide. This mixture is painted on with a brush, and is used to renovate the old diaphragm. In this cell the anode corrosion is very small indeed, and may almost be left out of consideration.

D

ELECTRICITY IN PRINTING WORKS.

The works of the Co-operative Printing Society, Manchester, have recently been considerably extended, and an installation of electric lighting and driving throughout has been erected. The installation consists of about 60 motors and 750 lights, the whole of the work having been carried out by Messrs. Electromotors, Ltd., Openshaw, to the specification of Mr. Frank Broadbent, M.I.E.E., of London.

The works, which were formally opened on Saturday, July 27th, were then visited by a very large number of friends, who were afterwards entertained to luncheon in the large hall of the Co-operative Wholesale Society.

Each of the printing machines is driven by a separate motor, this applying even to the small Platen machines, which take only about ½ H.P. each. Whilst it is unusual to individually drive such small machines, the method was entirely justified in this instance, as a wide range of speed control was required for each machine, and it was desired to abolish entirely all overhead shafting and belting. The machinery has been entirely rearranged in consequence of the electrical driving, and the conditions now existing in the main machine room are almost ideal. Automatic starting switches have been used for all the flat bed machines, and specially designed speed regulators permitting of fine speed control are fitted to all the individually driven machines.

In a brief speech at the opening ceremony, the society's consulting engineer, Mr. Broadbent, referred to the special advantages of electrical driving as applied to printing machinery. As to the economy of power, he mentioned that it had been possible in these works to arrive at a very accurate estimate as to the losses which take place in mechanical systems of driving by shafting and belting. The engine, boiler and chimney stack occupied a space which must be cleared before the extensions could be proceeded with. To permit of their removal without interfering with the carrying on of the regular work, temporary motors were erected on each of the floors, these motors therefore performing the same work as the old engine did, but with the exception of the main drives from floor to floor. The energy consumed under those conditions was almost exactly double what is now consumed since all the machines have been equipped with their individual motors. Several new machines had been added, some of these being the largest in the works, so that if the energy consumed by these could be deducted from the present consumption, it would be seen that the energy required to drive the shafting and belting alone in the old days was considerably more than is now required by the motors to drive the machines themselves, notwithstanding the fact thas these machines are turning out a greater output than formerly.

It was interesting to note, too, that the consumption of energy for lighting and power combined was considerably less than that required for power alone when the old shafting and belting were in use.

Many of the visitors expressed their admiration at the completeness of the electrical equipment, and there is no doubt that the Co-operative Printing Society have a very up-to-date installation, and are now in an exceptionally favourable position as regards turning out with expedition the highest class of work in their particular lines.

Preparation of a Non-Hygroscopic Fertiliser from Calcium Nitrate.—Herr E. Kollett and Det Norske Aktieselskab for Elektrokemisk Industri, of Christiania, have taken out a Norwegian patent for a process of preparing from calcium nitrate an artificial fertiliser which contains more nitrogen, and is free from the inconvenient property of hygroscopicity. (Calcium nitrate, it will be remembered, is the salt which is usually made from the nitric acid obtained electrically from the atmosphere.) The process consists in mixing the calcium nitrate with a proper quantity, *i.e.*, about 40 per cent. of ammonium sulphate, and mixing them together either in the state of powder or by melting the calcium nitrate. The product is a double salt, or a mixture of calcium sulphate and ammonium nitrate which is stated to have the properties already mentioned. If the original calcium nitrate contains an excess of any base, it is advisable to add a corresponding quantity of superphosphate, or some other material, having an acid reaction.

THE BRITISH ASSOCIATION MEETING AT LEICESTER.

The annual meeting of the British Association for the Advancement of Science, which was opened on Wednesday, July 31st, came to a conclusion on Wednesday this week, and though there was a comparatively low total attendance (1,700), it must be said that the Leicester meeting was quite successful, so far as presidential addresses, papers and discussions are concerned.

The Association presidential address was delivered by Sir David Gill, the progress and wonders of astronomical science naturally being his theme.

Section G (Engineering), in which papers of practical electrical engineering interest are considered, was presided over by Prof. Silvanus P. Thompson, who delivered in his own inimitable manner a masterly address, to which we referred last week. During five mornings that were given up to work there were papers, sometimes followed by discussion, on such subjects as gas and petrol engines, gaseous explosions with special reference to temperature, tuning in wireless telegraphy, the Pupin method of working trunk telephone lines, oscillographic study of low-frequency oscillating arcs, developments in electric incandescent lamps, Finsbury Technical College Engineering Laboratory Equipment, ferro-concrete, tram-rail corrugations, modern machinery developments, resistance coils, the governing of hydraulic turbines, application of water power, and so on.

In Section A there were various papers and discussions on radium and radio-activity, the constitution of the atom, the density of the ether, &c. The presence of Lord Kelvin, Prof. E. Rutherford, Sir Oliver Lodge, Prof. Larmor, and Sir W. Ramsay gave a special interest to the proceedings of the Section in these matters. The report of the Committee on Electrical Standards was submitted. Of the numerous papers in these two Sections we shall give abstracts in the course of the next few weeks.

Next year the Association is to meet in Dublin from September 2nd to 9th, with Mr. Francis Darwin, F.R.S., as president. It will be noted that after two years' experience of meetings held in Bank Holiday week, a reversion is being made to the month of September.

Thursday, Aug. 1st.—The Presidential Address delivered by Prof. Silvanus P. Thompson in the Engineering Section was listened to with wrapt attention by an audience that was somewhat smaller numerically than is usual with the G sectional address. Among those present were Colonel Holden, a vice-president of the Section, Colonel R. E. Crompton, Prof. Hele-Shaw, Prof. Hudson Beare, Mr. Robert Hammond, Prof. B. Hopkinson, Mr. Dugald Clerk, Prof. Andrew Jamieson, Mr. Hawksley, Mr. W. A. Price (recorder). The thanks of the Section for his address were accorded to Prof. Thompson by Col. Crompton and Prof. Hele-Shaw. The former congratulated the Section on its choice of a president whose great qualities were unrivalled powers of memory and logical arrangement of his ideas, and a conscientious desire to do justice to those who had taken part in the development of any great engineering work. He had given them that day a history of electrical development, to which he had added his supplementary work on education. No man surpassed him as a truthful and fair historian, and he was probably of equal eminence as an authority on education. Prof. Hele-Shaw, who seconded, acknowledged his indebtedness to Prof. Thompson, under whom he studied 31 years ago at Bristol, and referred to the inspiring influence of the Professor upon the thousands of students who had come under his instruction.

The Section then settled down to a consideration of a paper by Mr. Dugald Clerk on "The Present Position of Gas and Petrol Engines." The principal point in the paper that aroused discussion was the author's brief reference to the Johannesburg gas power station failure. The afternoon was devoted to a visit to the hosiery manufactory of Messrs. N. Corah & Sons, where there is a great deal of interesting machinery, and where ironing is done by electrically-heated irons.

In Section A, the Presidential address was delivered by Prof. A. E. H. Love, F.R.S., the theme being a dynamical theory of the shape of the earth, or in other words, the origin of continents and oceans. Among the papers that followed in this Section were:—

"Helium and Radio-activity in Common Ores and Minerals," by Hon. R. J. Strutt, F.R.S., and a paper by Lord Kelvin on "The Motions of Ether produced by Collision of Atoms or Molecules, containing or not containing Electrions."

Friday, Aug. 2nd.—Section G on Friday gave itself up to a morning's discussion jointly with the members of the Chemistry Section on "Gaseous Explosions with Special Reference to Temperature," after Prof. B. Hopkinson had read a paper on "The Gases Exhausted from a Petrol Motor." The afternoon was spent in a visit to an exhibition of shoe-making machinery, and there was a garden party in the evening. While "G" was engaged with the

above discussion, there was proceeding an important debate in the Mathematical and Physical Science Section on "The Constitution of the Atom." There was a very large audience. The subject was opened by Prof. E. Rutherford, F.R.S., and he was followed by Sir Oliver Lodge, Sir Wm. Ramsay, Mr. F. Soddy, Mr. G. A. Schott, Prof. Larmor, and last by Lord Kelvin, after which Prof. Rutherford "who was sorry to have been the football both of the physicists and the chemists" in the debate, said a few words in reply. The Section then proceeded to consider a number of papers, among them:—

"On Variability in the Products Resulting from Changes in Radium Emanation." By Sir W. Ramsay.

"Pseudo High Vacua." By F. Soddy and T. Mackenzie.

"On the Nature of Ionisation." By Prof. H. E. Armstrong.

"The Range of Freedom of Electrons in Metals." By Prof. J. Larmor.

In the evening of Friday, Mr. W. Duddell delivered a discourse in the Opera House on "The Arc and Spark in Radio-Telegraphy.' Neither "A" nor "G" sat on Saturday, but a party from the latter Section devoted the day to an expedition over the Leicester and Swannington Railway. Mr. Clement Stretton acted as conductor.

Monday, Aug. 5th.—Monday morning was a busy time in Section G, and the papers read were almost exclusively electrical in interest. For the greater part of the morning the attendance was very gratifying.

The proceedings started off with a paper by Sir William Preece on the "Pupin Mode of Working Trunk Telephone Lines." Owing to the length and technical character of the paper, Sir William gave only an ample abstract, and in the discussion that followed, Sir Oliver Lodge, Mr. S. G. Brown and President Silvanus Thompson took part.

Sir Oliver Lodge then read in abstract, and with blackboard illustration, his paper on "Tuning in Wireless Telegraphy." Prof. Thompson, Sir Wm. Preece and Prof. Trouton discussed certain points, and the author briefly replied. Prof. J. T. Morris came on next with his "Note on an Oscillographic Study of Low Frequency Oscillating Arcs," his various oscillograms, &c., being shown by means of the lantern. A few brief comments on the paper were made by Mr. S. G. Brown and Mr. Petavel.

Mr. L. Gaster then followed with a paper on "Developments in Electric Incandescent Lamps." As the hands of the clock were travelling somewhat too quickly, the author had to give his paper in the form of what the President described as a "quick *résumé*," but the communication was of practical interest as showing the advance that is so rapidly being made in connection with metallic filament lamps. The President remarked upon the progress that the subject had made since it was considered before the Section last year. The paper was made the more interesting by the passing round of representative lamps of all the different types introduced or announced up to date, including what we were told was the first specimen of the Helion lamp to be shown in this country. Mr. Gaster has only recently returned from the States, where he has been closely investigating the latest developments in electric lamp invention and manufacture, and the paper contained much interesting matter as the direct result of that visit. Sir Wm. Preece made a few remarks concerning his experiences with Osram lamps at his residence in Wimbledon and with tantalum lamps at his house in Wales. Col. Crompton said that the increasing smoke pall over our large towns had necessitated the use of 30-c.p. lamps where 8 c.p. were formerly used. They would have to abandon 5 and 8-c.p. lamps. The new and more efficient lamps had come as a great boon, and at the right time, to the electric lighting companies. Questioned by Mr. Hawksley as to his increasing "smoke pall" remark, Col. Crompton said that taking the whole year that remark was correct. It was much darker in summer. They had less fog but more persistent dark days when the lights had to be on all day. That was undoubtedly the case from statistics that the lighting companies had prepared. Mr. Gaster was to have exhibited his various types of lamps alight, but the building in which "G" was meeting was fitted up for illumination by that mixture which is sold at so much per 1,000 c.f. It was announced, however, that arrangements had been made for all the lamps to be shown in actual operation at the Museum on Tuesday, the night of the Conversazione. Mr. Gaster introduced at the end of the discussion what he called a new born baby—a 160-c.p. lamp with Zircon-Wolfram filament consuming 160 watts, but the filament itself was not visible—a frosted bulb generally hides things. The chairman closed the brief discussion with the remark that it now appeared that we had a standard to work to of 1 candle per watt.

Mr. E. G. Coker brought a good morning's work to an end with his account of the Equipment of the Engineering Laboratory of the Finsbury Technical Institute.

Tuesday, Aug. 6th.—For two hours on Tuesday morning the members of Section G were entertained with two very timely and profitable papers on ferro-concrete and the remarkable development that has been taking place in this direction during the past few years. Both papers were illustrated by a host of lantern slides showing constructional operations in progress, and completed structures, chiefly on the Hennebique system. Mr. Worby Beaumont then read his paper on the origin and production of corrugation in tramway rails, and the fact that we have yet a lot to learn in regard to this matter was once more emphasised in the brief discussion that followed. "Modern Machinery and its Future Developments," was read by Mr. H. I. Brackenbury, and "Resistance Coils and their Comparison," was contributed by Mr. C. V. Drysdale. In Section A, among other items, was a report of the Committee on the "Teaching of Elementary Mechanics."

Wednesday, Aug. 7th.—The papers down for reading on Wednesday in G, included the following: "Note on the Governing of Hydraulic Turbines," by Mr. R. S. Ball; "A Machine for Weighing the Forces of a Cutting Tool," by Mr. J. F. Brooks; and one by Mr. J. Smyth on "The Application of Water Power and how to Secure the Greatest Efficiency in Working the Same."

The Present Position of Gas and Petrol Engines.

By Dugald Clerk, M.Inst.C.E., F.C.S.

(*Section G.—Abstract.*)

The present position of the internal combustion motor industry in Great Britain is one of sound commercial prosperity. At no previous time have the gas and oil engine builders had so many orders in hand, and never before have these motors been applied so successfully to so many different purposes.

Smooth success, however, is not interesting from the point of view of the scientific investigator or inventor; and, accordingly, I propose to discuss the present position with regard to existing difficulties rather than existing successes.

Engines of small and moderate powers are built in large quantities; their difficulties have been thoroughly overcome and they have attained to an almost fixed type. The larger part of the British gas engine industry is occupied with such motors, generally under 100 h.p. per cylinder. The turnover in Britain at present of such engines is at the rate of some 300 engines per week. It is generally recognised that these engines are as reliable as the best steam engines of similar dimensions and much more economical in fuel consumption. The smaller engines mostly use coal gas, and the larger producer gas evolved by means of modern suction producers using anthracite for fuel.

Large gas engines of English design have also been built in greater numbers, principally by the Premier Co., Messrs. Crossley Bros., Ltd., and the National Gas Engine Co. English designers have always felt the desirability of keeping down cylinder dimensions as much as possible, and in this Continental designers have recently shown a strong tendency to follow them. This trend is due to a more general recognition of two facts: practical difficulties with large diameter cylinders due to unequal expansions resulting in cracking, and a better appreciation of the fact that increase in cylinder and other dimensions requires an increased expenditure in metal and workmanship in greater proportion than increase of power obtained. The large gas engine really presents two distinct problems. The first is to build engines of large power which will continue to run effectively and economically for long periods without breaking down, and the second is to build such engines at costs sufficiently moderate to enable the engines to compete effectively with the large steam engines in the matter of first cost. British engineers have recognised for some time that the first part of the problem has been solved to some extent on the Continent, but many of them have felt that this solution has involved weights of material and costs of construction which are almost prohibitive, considering the moderate powers obtained. In fact, English engineers consider the large gas engine as it at present exists both too heavy and too costly for its power. Personally, I do not believe that sound and continued commercial success can be looked for with really large gas engines until some better solution be found for their present constructive difficulties.

Apart from the questions of the engines themselves, there are other difficulties which prevent the equal competition of gas engines with steam engines for powers, say, greater than 400 or 500 horse. Coal gas is too expensive a fuel for large engines. Producer gas, evolved by the suction producer from anthracite, air and steam, effectively meets the wants of medium-sized engines up to 200 horse, but the cost of anthracite handicaps engines of larger size, and equal competition will not be possible until better bituminous fuel producers are designed than those which at present exist. The work on the Continent has not aided the solution of the bituminous fuel producer problem. Practically all the large Continental gas engines are operated with blast-furnace gas. Some success has been attained in Britain as the result of strenuous and praiseworthy efforts by Dr. Mond, Messrs. Crossley and others; but it cannot yet be said that an entirely satisfactory bituminous producer has appeared. In my view, no bituminous fuel producer can be considered really satisfactory until it attains simplicity, lightness and the fewness of parts of the anthracite suction producer which now forms so large a British industry

Returning, however, to the engine difficulties, the large gas engine may be considered as combining the difficulties of hydraulic engineering work at considerable pressures with those proper to a boiler furnace or flue. The possible pressures to be resisted by such engines cannot be taken as less than 400 lb. to 500 lb. per sq. in., and a heat flow through the cylinder and combustion chamber walls has to be provided for greater than that of most boiler furnaces. It is obvious that here we have contradictory conditions involved which become rapidly onerous with increase of dimensions. Thick castings are required to stand the high pressures, but to allow free heat flow from the flame within the cylinder to the water in the water-jacket calls for thin castings. Engines of small dimensions do not involve any serious conflict, but where metal is required of about 3 in. thickness to resist internal pressures, the temperature difference between the flame and water side of the metal becomes serious, and great stresses are set up which ultimately lead to the

cracking of the castings. Great attention has been paid to this phenomenon of cracking, and in existing large gas engines the difficulty has been partly met by skilful design and special quality of metal used. Although much ingenuity and skill has been spent in this direction, yet it is found that a dimension limit is very soon reached. Cylinders, for example, of 51 in. diameter have been found to be too large. Nothing but the highest skill in designing and the greatest care in the choice of material and workmanship enables such cylinders and combustion chambers to withstand for any length of time the severe treatment to which they are exposed.

In a paper which I had the honour to read at the Cambridge meeting of the British Association, I directed attention to the question of the working fluid of these engines, and described experiments which I had made and engines which I had built with the aim of reducing the mean temperature in order to reduce heat flow. Good results were obtained with these engines, but I came to the conclusion that the methods of reducing temperature then adopted did not go far enough. For the last three years I have been attempting to reduce maximum pressures as well as temperature, without reducing mean pressures, in order to diminish the weight of the engines for a given power and to secure moderate thickness of cylinders and combustion chamber castings. There are several ways of reducing temperatures and maximum pressures without reducing mean pressures, but all require much more accurate knowledge of the properties of the working fluid than we at present possess. One solution of the problem appears to lie in compounding, and I am now at work on this. Many attempts have been made to compound the gas engine by Dr. Otto, Messrs. Crossley, Mr. Butler, Messrs. Dick, Kerr & Co. and others, and I myself have also at various times built experimental compound engines. No success, however, has yet been attained. There is no difficulty in getting some work from the low-pressure cylinder, but the additional work obtained was always too small in amount to justify the expense of the separate cylinder. The lack of success was mainly due to ignorance of the rates of cooling of the working fluid at different temperatures and pressures. Experiments made with closed vessels do not give much information on the necessary points. I found it necessary to make experiments of this nature on the engine itself in its working condition instead of on closed vessels. At the beginning of 1905 I designed a new method and performed a considerable number of experiments on a 50-H.P. gas engine, by means of which I obtained a cooling curve in the actual engine cylinder and much other information of a useful nature both from the scientific and the practical points of view. From this curve the apparent specific heat of the charge can be obtained for each expansion line. Tables I and II have been calculated from the numbers so obtained. These tables clearly show that the apparent specific heat of the working fluid, which consists of the products of

TABLE I.—*Apparent Specific Heats (Instantaneous) in Foot-Pounds per Cubic Foot of Working Fluid at 0° C. and 760 mm.*

Temperature. Deg. C.	Specific heat at constant volume. ft.-lb.	Temperature. Deg. C.	Specific heat at constant volume. ft.-lb.
0	19·6	900	26·6
300	23 0	1,200	27·2
600	25 2	1,500	27·45

TABLE II.—*Mean Apparent Specific Heats in Foot-Pounds per Cubic Foot of Working Fluid at 0° C. and 760 mm.*

Temperature. Deg. C.	Specific heat at constant volume. ft.-lb.	Temperature. Deg. C.	Specific heat at constant volume. ft.-lb.
0—100	20·3	0—900	23·9
0—300	21·4	0—1,200	24·6
0—600	22·8	0—1,500	25·2

combustion in the cylinder of this particular engine, increases considerably with temperature, so that the instantaneous value is about 28 per cent. greater at 1,000° C. than it is at 100° C., while at 1,500° C. the increase amounts to 31 per cent. The mean apparent specific heat between 0° C. and 1,000° C. is 15 per cent. greater than it is at 100° C.; between 0° C. and 1,500° C. it is 20 per cent. greater. These apparent specific heat numbers enable me to obtain a curve of heat loss to the sides of the cylinder either for complete double strokes or for partial double strokes at the inner end of the stroke. Fig. 1 shows four such curves. The curves (a) (b) represent the heat losses incurred in complete revolutions—that is to say, in complete double strokes. Here the surface exposed and covered alternately is that due to the whole sweep of the piston. The curves (a′) (b′) represent losses incurred at the upper three-tenths of the double stroke, while the piston moves from three-tenths stroke to the end, compressing into the clearance space, and then moves out again to the point of three-tenths of the outward stroke. The ordinates give heat loss in foot-pounds to the second and the abscissæ mean temperatures per total stroke or double three-tenths stroke. This table gives interesting information enabling approximate calculations to be made dealing with the durability of the working fluid exposed to cylinder surface. It has enabled also important facts to be discovered as to the mean temperature of the cylinder walls and the heat flow with varying density. Curves (a) (a′) were calculated from experiments made with the engine running without load at 120 R.P.M., jacket water kept at a mean temperature of 13° C. Curves (b) (b′) are calculated from experiments made with the engine running at 160 R.P.M. with a load of 150 B.H.P. and jacket water at 80° C. The curves are accordingly marked as "Engine cold," "Engine hot." Where the engine is running cold the mean temperature for the complete strokes of the walls is shown to be about 65° C., notwithstanding that the jacket water is 13°. For the three-tenths stroke, running cold, wall temperature 165° C. With the engine running hot, the whole stroke shows mean temperature of walls 190° C.; for the inner three-tenths 400° C. These numbers, giving quantitative values of heat loss for a given cylinder, enable the conditions within the cylinder walls to be realised with some accuracy. In this particular engine the walls of the combustion space are about 1¼ in. thick; and calculating the temperature gradient in those walls for the heat flows, given temperature difference, say, 700° C., between gas and interior of the

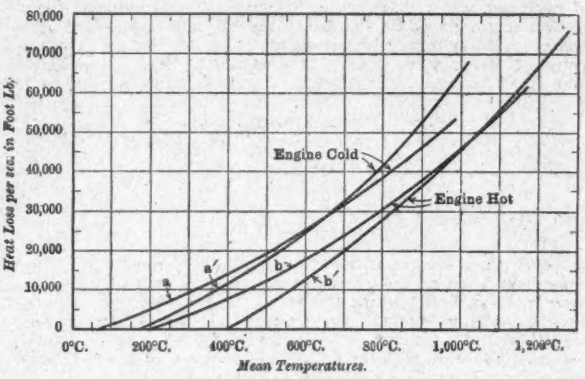


FIG. 1.

wall, gives a temperature difference in the metal between the water side and the gas side of 60° C. A temperature difference of 1,000° C. between gas and inner wall gives temperature difference in the metal of 104° C. These differences are accentuated with greater metal thickness almost in proportion to the thickness; thus with the higher temperature to the last calculation a thickness of 3¾ in. wall would give a temperature difference in the metal itself of over 300° C. These numbers throw an important light upon the problem of the large gas engine, and enable me with some confidence to experiment upon the variations of indicator diagram and the transfer of hot gases from cylinder to cylinder required in successful compounding. The experiments show also many interesting and unexpected facts in connection with the behaviour of high-temperature working fluid in these engines. Much remains to be done, however, and I am continuing the investigation on three engines with the object of determining the laws of the working fluid within the gas-engine cylinder more completely.

In modifications of the conditions of the working fluid combined with mechanical modifications of the engine using it, I hope to find in the near future some more satisfactory solution of the large gas engine problem than at present exists. It appears to me that the problem is one more of working fluid than of pure mechanism. So far, however, the conservative attitude of British engineers towards large gas engines has been fully justified. Progress in solving the large gas engine problem has been somewhat slow, but it has been steady. There is no occasion whatever for discouragement, notwithstanding recent difficulties with a large gas engine installation at Johannesburg, of which much has been written in the engineering publications. The difficulties at Johannesburg are, in my opinion, to a large extent due to the daring nature of the experiment undertaken by an eminent firm of engineers whose experience was rather in steam engines than in gas. They very boldly attempted to solve at one stroke the difficulties both of the large gas engine in itself and those peculiar to the bituminous producer. I have no doubt that if they be given time they will solve these difficulties, but the experiment was on too large a scale for most experienced gas engine constructors and designers. I do not attach any importance to this partial failure. It emphasises, what I have always held, the necessity for precaution and much further study in connection with the large gas engine problem. It appears to me, however, eminently unwise and unsafe to attempt to solve the numerous problems involved in too short a time. Gas engine builders must be content with the slow growth of experience and the slower solution of these difficult problems.

As I have already said, part of the large gas engine problem depends upon the producer. A bituminous fuel producer of a type suitable for use on shipboard has not yet been devised, and until such a producer is designed and thoroughly tested the anthracite suction producers of to-day will not allow any great extension of gas motive power to large sea-going vessels. Mr. Capitaine has, I am informed, applied an engine of 300 H.P. to a towing vessel on the Rhine, but as yet this movement is in its early infancy.

The great success of the suction producer in connection with stationary engines on land has enabled the power of gas engines in use to be very materially increased. Tests at the Royal Agricultural Society's show last year have proved that even small producer-driven engines only require 1 lb. of fuel per brake-horse-power per hour, including lighting-up and stand-by losses of the producer at night. Other experiments, some of them by myself, show very clearly that with a good suction producer we can obtain 85 per cent. of the whole heat of the fuel in the form of inflammable gas ready for delivery to the engine. Many tests have shown that the running consumption of many of these engines at full load does not exceed ¾ lb. of anthracite per brake-horse-power per hour.

In this paper I have not dealt with the question of thermal efficiencies at all. The thermal efficiencies of all gas and internal

combustion engines are very high compared with any other form of heat motor. In recent tests by the Thermo-dynamic Standards Committee of the Institution of Civil Engineers, an ordinary "National" gas engine gave an indicated efficiency of 35 per cent. and a brake efficiency of as nearly as possible 30 per cent. The efficiency obtained from smaller petrol motors is somewhat less, but in tests made by Hopkinson it rises as high as 24·6 per cent. This is a very high efficiency for a small-diameter cylinder.

So far as I understand the question, although large increases in thermal efficiency are still probable, efficiencies are quite high enough at present for all practical purposes, and the main efforts of engineers and scientific men interested in the internal combustion motor should be directed to the solution of the large gas engine problem in such a way as to reduce weight and increase power of the unit; to improve the bituminous fuel producer; to apply the improved engine and producer to marine purposes and overcome the various difficulties there presented; in petrol engines to design carburetters capable of proportioning the charge more accurately than at present under all conditions of running, whether with light or with heavy loads.

Discussion.

Mr. Worby Beaumont said that some of the great practical difficulties in the way of very large gas engines appeared to be a very long way from solution at present. In regard to the temperature of very large engines, the question arose as to how far the work that had been done by builders of the very small engines referred to in the paper might give some hope of making large engines, not of such large diameters of cylinders, but larger powers by means of the successful use of higher speeds of revolution.

Col. Crompton corroborated some remarks of the last speaker as to the difficulties that electrical men felt in regard to the use of the large gas engine for producing electricity. They had all had great benefit from the use of the producer gas engine for small sets of plant. It had been the means of enabling them to give a direct supply to small towns which would have been impossible without it. But they had to proceed very cautiously when they tried to use it in large units, and the reason had been quite apart from such difficulties as those that had arisen at Johannesburg; the difficulties had been in connection with the producer itself. The anthracite and the coke used hitherto were really not available in sufficient quantity, or in the places where they required to use them, to render them really useful, say, for electrical supply in London. He was a member of a committee of the companies of London which was considering the whole question of the better supply of London, and bringing it up to the most perfect possible condition, and they had had that gas engine problem before them. One reason why it had hung back was that question of the bituminous producer. Elihu Thomson once, in the middle of the night, in talking to him about how to make big cylinders for internal combustion engines, expressed the idea that one day they would have to impart strength to the cylinders by a metal frame-work filled in with a concrete of fused quartz. It was possible to do it, and it might be many years for it to be realised, but there were all the elements, if they could be put together. He only told them what Elihu Thomson said in the middle of the night.

Mr. A. R. Sennett said that certainly nearly 30 years ago, Prof. John Perry made exactly the same suggestion to him that the cylinder should be make of quartz or some similar refractory material.

Prof. Andrew Jamieson said that Mr. Clerk had dealt very gently with Johannesburg, and he admired his policy of saying as little as possible. They all felt that probably a little more careful investigation, and advantage taken of years of practical and scientific knowledge of foreigners, would have prevented that disaster.

Prof. B. Hopkinson having said a few words regarding methods of measuring the temperatures of cylinders,

Prof. Hele Shaw said that he was living in Johannesburg when that gas plant was installed, and he had opportunities of carefully examining the work. Nothing could have been more beautiful than the construction. The engines were made and the work done in the most perfect way possible for engineering. There was no scamping. Every chance had been given. It had been by far the biggest experiment of the kind, and was a failure through the want of that very knowledge that they had heard about that morning. In regard to the use of that coal, the engineer was confident. He said that engines of the same size had been working in Germany, and there could be very little difference between the qualities of the different coals. It showed how necessary it was that experiment should go hand in hand with every step of progress. He was afraid it had set back the development of the large gas engine. It was all very well to condemn the man who took a bold step forward, and had met the penalty of advance, but he felt every sympathy for those who had made a bold step and suffered from having to learn experimentally what might have been learned at less cost on a smaller scale.

Prof. Hudson Beare said he understood that those engines were adopted strongly against the advice of a friend of his, and he had had the opportunity of congratulating him upon being a good prophet.

Colonel Holden was making some remarks when he was interrupted by Prof. Jamieson, who said, among other things, that an immense amount of practical and scientific information was available, which was now being taken advantage of when it was too late.

In the course of his reply, Mr. Dugald Clerk said that if they must have pioneers, they must have martyrs as well. They could not have any daring without coming a nasty cropper sometimes. One admired the daring and courage of those who took up an installation like that at Johannesburg. The tendency amongst gas engine designers was to limit the diameter of the cylinders, and increase the number of cylinders. Colonel Crompton said what he expected he would say, that electrical engineers were rather anxious about large gas engines, and especially large producers, but an enormous advantage had been gained by the small suction producer. There was no doubt that many towns and villages would not have had electric light now, but for the recent perfecting of the suction producer. As to the difficulty about the supply of anthracite, this had been rising as the success of the producer had increased the price. There seemed to be something like 100 suction producers built and sold in Great Britain every week. With regard to the interesting idea of Elihu Thomson that he would make big cylinders of molten quartz and stiffen them up with iron, if he once built a big engine that way he would not do it again. He had not realised the large gas engine cylinder. There they wanted a conductive material that would get rid of the heat as quickly as possible. He did not doubt at all that the Johannesburg engines were splendidly made from the pure engineering point of view. From Continental engines they could learn something, but there were practically no large Continental engines working with any other gas than blast furnace gas, and that was one thing to which people did not attach sufficient weight. The difference in the composition of the gas made all the difference between success and failure. He did not think that in bituminous producers we had anything to learn from the Continent. He thought the Johannesburg trouble must have been partially a gas difficulty, but judging from what one heard, it was a producer difficulty. They had also heard of some mechanical difficulties in the engine house. It was a great pity that this should have happened, but there was no reason to be discouraged. One did not wish to dwell too much on the discouraging side. There was much on the encouraging side. This disaster could be explained by the fact that the British were a little more venturesome than they ought to be. Directors of commercial undertakings must be very careful in spending shareholders' money in building large gas engines. They were building National gas engines of 400 H.P. regularly, but they had not yet got to 2,000 H.P.

The Origin and Production of Corrugation of Tramway Rails.

By W. Worby Beaumont, M.Inst.C.E.

(Section G.—Abstract.)

That which is known as "corrugation" of the surface of tramway rails has given rise to much speculation and some investigation concerning its cause. Although known as corrugation, it is hardly perceptible as of a form usually understood when so described. It consists of an approximately regular alternation of hard and soft, or of hard and less hard, patches of the surface rolled by the tramcar wheels. The surface of the hard patches is very slightly higher than the general surface, but it becomes sufficiently so to declare its existence by the noise made by the tramcar wheels as they roll along the rails as though running over a rack with teeth of almost no assignable height.

Although the physical and mechanical conditions involved in the origin of corrugation may be said to be somewhat complex, the mode of operation of the causes is simple, and for an explanation, simple phenomena of known recurrence and adaptation in engineering works may be appealed to for this purpose, and for some of these the author may refer to a paper he read before Section G at Liverpool "On the Causes of Fracture of Railway Rails": "When a piece of cold iron or steel is subjected to pressure exceeding the limit of elastic compression by a rolling or hammering action, or by both these combined, the result is spreading of the material and general change of the dimensions.

". . . . In the case of railway rails the freedom for the flow of the material is very limited, especially when considered with reference to the rolling and hammering media and the surface contact between rails and wheels. Hardening of the surface takes place, and destructive compression of the surface material is set up."

The repeated running of the heavily laden tramway wheel over the rail does thus gradually compress the surface of the crown of the rail. Of this stress transversely the material relieves itself partially by detrusion at the edges of the rail, where it forms a lip both on the outside and the groove side. This lip remains on the outside of the rail, but is worn off on the inside by the wheel flange. In the longitudinal direction, the stresses arising from the compression of the surface material are not thus relieved, and the result is the formation of an extremely hard surface in patches of various shapes and lengths. Sometimes this hard surface is continuous, with but slight breaks of intermediate slightly roughened surface. In many places the surface between the hard bright patches is pitted with various degrees of coarseness of pitting. Where the bright hard patches alternate with an approach to regularity with the dull and rougher surface patches, the result is known as corrugation. This character of surface may be found on every heavily-worked tramway under conditions of such impartial contrariety that it may be ascribed to conditions of origin which are general. They are found in straight level lines and on straight gradients. They are found on curves, and especially on curves of moderate and large radii, and they generally appear soonest on the outer rail of a curve.

The author offers the following, then, as the explanation of the origin and production of the corrugation of tramway rails:—

1. The compression of the material of the table of the rail by the tramcar wheels; cold rolling.

2. The microscopic deformation of the surface of the rail on the small area of contact between wheel and rail, that deformation being attended by a depression under the wheel.

3. That the material of the surface in front of the wheel and the depression recurrently forms a slight ridge of unassignable height, over which the wheel mounts.

4. That the area of contact between wheel and ridge is minute, and the pressure, therefore, very great per unit of area, and hence the severe pressing of the ridge into the material of the rail table and its hardening or its crushing.

5. That the distance between each ridge thus formed by the rolling wheel will vary slightly with the strength, hardness and toughness of the rail, and with the speed of the car wheels.

6. That the originating ridge forming the incipient hard patch is added to on the formative or rear side, thus gradually extending from a mere transverse line to an area of increasing length.

7. That the hard patch thus formed for a time resists the destructive deformation by the wheel, but that it increases the rate of local side detrusion, and that the extruded material is in some positions of the rail worn off by the flanges of the wheels, which are thereby pushed laterally against the other side of the rail groove, and make more or less distinctive marks thereon.

8. That a steel rail loses a large part, if not most, of its weight in wear by the separation of the compressed and crushed surface by minute exfoliation, the surface film exceeding the dimensions of the sub-surface, and separating itself by disintegration, flaking, or crumbling as shown by pitting.

9. That this disintegration of the surface partially relieves the surface film of the destructively compressed parts and the sub-surface of the corresponding tension.

10. That the hard bright patches depend for their duration upon the strength of their supporting materials, and in many cases should disappear, though they reappear in different position.

11. That the appearance of the hard patches on the outer curves of some lines where none appear on other of the rails of the same line is due to the heeling over of the cars on the curve and the extra weight thereby put on the outer wheels on this outer curve.

12. That it is possible that the final passes of some rails through the rolls at a comparatively low temperature may produce a condition in the rail conducive of initiation of corrugation, and thus accessory before the rail is laid.

13. That there are numerous circumstances and conditions in the working life of a tramway rail which produce great contrariety in results, including (*a*) its correct laying, which causes a greater or lesser width of the table to present itself to the wheel thread; (*b*) the grinding slip of the propelling wheels on one side of the car affected by the condition of the rail surface and by the heavier load on the outer rails on curves causing or permitting the wheels on the inner rails to slip; (*c*) the speed of the cars; (*d*) the character of the dirt and grit on the rails, the constitution of the rail, &c.

14. The remedy appears to be: (1) lighter cars; (2) harder rails; (3) moderate speeds and larger wheels.

15. Some excellent examples of the corrugation in numerous stages of production with long, short, narrow, wide, somewhat irregular, extremely irregular, and other illustrations of the vagarial appearance of the disease may be seen on the new tramway of the London County Council on the Thames Embankment between Blackfriars Bridge and the Temple Gardens. A good deal might also be seen there in Leicester.

[In the brief discussion that ensued Col. Crompton, Mr. Sennett, Prof. Hudson Beare, and the president of the Section took part.]

Note on Tuning in Wireless Telegraphy.

By Sir Oliver Lodge, F.R.S.

(*Section G.—Abstract.*)

The principles of tuning were clearly explained by Mr. Duddell last Friday, and I shall assume them known; but it is not to be supposed that the application of these principles requires the arc. Sufficient tuning for all practical purposes can be obtained by using the right kind of spark. It is possible to require too long a train of waves, in which case the latter half of the train will undo what the former half has begun, in analogy with beats. Thirty or forty swings can be easily got by a spark, and that is enough for practical requirements.

Kind of Spark.—A non-tuned station puts all the energy into a single snap, so as to produce a single discontinuous pulse calculated to affect every kind of station within the range of its power. For a tuned station this sudden snappy spark is to be avoided. The ideal arrangement is a spark of a sufficient number of alternations of approximately equal strength, no one of which is sufficient to operate, but such that the accumulated influence of all of them is powerful. Instead, therefore, of the clean polished metal knobs in fresh or compressed air, which are suitable for a snappy spark, a tuned station may employ a series of points enclosed in ionised air so as to maintain conduction as long as possible. The maintenance is also assisted by using an alternator with a curve of the right shape—not a sine curve, but a high-shouldered curve—so as to keep up the stimulating potential for a sufficient time. It is this kind of spark which, at the Lodge-Muirhead station at Elmers End, was photographed by Mr. Duddell in a revolving mirror, and exhibited on Friday night.

Effect of the Earth.—But attention to the spark alone is not sufficient; it is necessary to eliminate the influence of the earth.

For the snappy or non-tuned emission, such as was employed by Mr. Marconi for given distances, it is convenient to use an elevated wire on the one hand and the earth on the other; but for a tuned station that is not appropriate.

A tuned station requires two capacity areas, both insulated and elevated above the earth, as published by me in 1897. These capacity areas are usually horizontal frames of shapes devised by my friend and partner Dr. Alexander Muirhead, who has found that there is a best position for the lower aerial, such that the capacity is a minimum. It was under these circumstances that the photograph above spoken of was taken, and the sending efficiency is most marked.

If the lower aerial be too much raised, the radiating power diminishes; if it be lowered, the train of waves is shortened until, when it is allowed to touch the earth—still more if it is connected with the earth—there is hardly any train of waves at all, and the discharge is almost dead-beat. There is a great advantage in thus getting rid of earth contacts, inasmuch as variations of moisture and uncertainties of the soil do not enter in to confuse the problem and throw the tuning out. But even if the earth remained constant, it would be deleterious it seems by its resistance to damp out the vibrations and shortens the train of waves, in so far as it is allowed to exert any influence.

Method of Receiving from a Distant Tuned Station.—The first thing is to tune up the receiver accurately. This can be done by a Duddell radio-micrometer, which measures the received energy satisfactorily although it is very small. Tuning is altered until the reading on this micrometer rises to a high value, then the receiving apparatus is purposely made insensitive, so that the coherer will only respond to this high value; in other words, to the top of the curve. The message can then be received from the desired station. If the receiving apparatus were left sensitive, it would be affected violently by the desired station, but it would pick up a number of disturbances from other stations. By working at the top of the curve it feels the desired station alone.

Perfection of Tuning.—In this way it was possible to receive at Hythe from Elmer's End, while a much more powerful and nearer station at Dover was making a disturbance which was entirely eliminated. It is easy to hear the ships in the channel, but it is also easy to tune everything out and listen to the desired station alone. A 5 per cent. change could be made to throw this out and throw a neighbouring one in; but in practice it may be undesirable to try to work quite so close as that.

With changes of that order of magnitude, however, several neighbouring sending stations can be made to send to several neighbouring receiving stations without interference. That is to say, diplex telegraphy is possible, though not duplex.

Tuning at the Sending End.—In order to economise power, it is desirable to have every part tuned. The aerials connected through the secondary of the peculiarly-made Ruhmkorff coil constitute one oscillating system of a low frequency to correspond with an ordinary commercial alternator which excites them. When the swing is worked up, they burst through the spark gap, short-circuiting out the Ruhmkorff and giving excessively rapid oscillations, which are the ones transmitted. These are picked up by the receiving station and transferred at constant frequency into a closed air-condenser circuit, which, when its swings reach a maximum, overflows into the coherer. This is called the "overflow method," and was described by me in 1889 and 1891.

Ratio of Received to Emitted Energy.—Theoretical calculation shows that the energy received, compared with energy radiated, depends on the cube of the linear dimensions of emitter and receiver, if they are alike, and likewise on the cube of the distance between them.

Measurements made with the radio-micrometer confirm this estimate approximately, the value in one series of experiments being 10^{-9}. Although this is a small fraction, the accuracy of tuning is such that messages are sent between Burma and the Andaman Islands—a distance of about three hundred miles—with less than a horse-power.

Other Precautions.—To get such a result, precautions must be taken to avoid damping out the oscillations, not only by elevation even of the lower aerial above the earth, but by using appropriate conductors for these excessively high frequencies. To this end, the wires are finely sub-divided into insulated strands, and consist of a great cable or bundle of thinly insulated No. 40 wires, and the various self-inductions and other arrangements for effecting tuning are similarly wound. The tuning capacities are also arranged so as to be continuously adjustable without pegs or discontinuities, and every kind of broken or uncertain contact is scrupulously avoided.

[Prof. S. P. Thompson, Sir W. H. Preece, and Prof. Trouton discussed the paper briefly, and Sir Oliver Lodge replied.]

Note on an Oscillographic Study of Low-Frequency Oscillating Arcs.

By J. T. Morris, M.I.E.E.

(*Paper read before Section G.*)

The present note collects together a few observations which have been made on direct and alternating-current arcs chiefly with the object of studying the effect of a change in the medium in which the arc is burning, and also to examine the effect, if any, produced on the arc by the application of a transverse magnetic field. It should be borne in mind that in no case were frequencies of more than 1,000 investigated.

The work of Messrs. Ayrton, Blondel, Duddell, Simon and others on alternating and direct-current arcs is so well known by those interested in this subject that it is needless to do more than refer to it.

In view of the great interest that has recently centred on the production of electric waves by means of oscillations in direct-

current arcs, the following experiments, which are somewhat fragmentary, were started last autumn in order to study at low frequencies the action of the separate factors which contribute towards the successful operation of the Poulsen arc.

Effect on Arc of Change of Medium—Coal Gas and Air.

Alternating Arcs.—The fact that an arc is more easily extinguished when burning in coal gas than in air has been quite recently

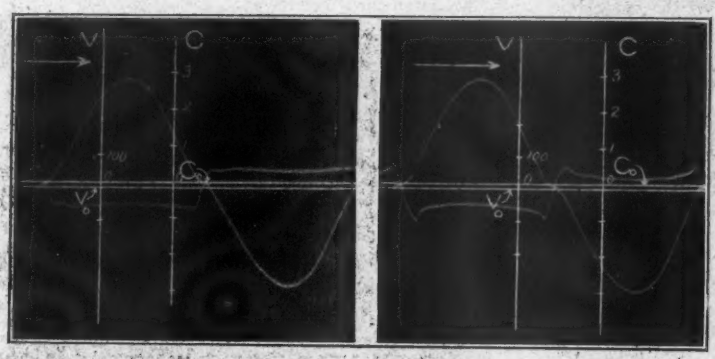


Fig. 1.—60 ~.

Fig. 2.—60 ~.

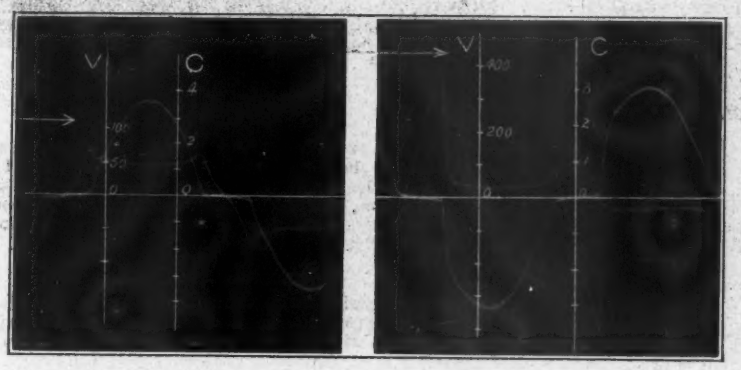


Fig. 3.—60 ~.

Fig. 4.—60 ~.

turned to account in more ways than one. Notably is this the case in the Poulsen arc; there are, however, minor applications such as its use in certain forms of interrupters for induction coils, as in the "moto-magnetic" interrupter. The author himself has found that the mercury jet interrupter, which is usually worked in paraffin oil or alcohol, is more efficient and far less troublesome to use if the paraffin oil or alcohol be replaced by an atmosphere of coal gas.

To further investigate this action of arc extinction these experiments were carried out, and oscillograms taken. In all experiments described below the arcs were taken between horizontal electrodes and the length of the arc, except in those cases where it is specifically stated otherwise, was adjusted to 1 millimetre—this being correct to a tenth. The alternating-current had a frequency of 60 ~. Where carbon electrodes were used they were solid and of 12 mm. diameter.

In fig. 3 is shown the behaviour of a 440-volt alternating arc in air. Fig. 3 has its voltage wave on the correct side of the zero with respect to the current, but in all other cases the current wave has been reversed intentionally in the oscillograms to prevent confusion between the volt and ampere waves. (Fig. 3 shows a 110-volt arc under similar conditions.)

In fig. 4 will be found the corresponding oscillograms for an arc under the same conditions, but working in coal gas. (In reality this oscillogram was taken with the arc in a magnetic field; the slight modification produced will be referred to later.) The notable feature is the dissymmetry of the voltage wave that is produced when coal gas is employed, the voltage rising to 370 volts before the resistance of the arc breaks down. From these oscillograms have been plotted the "dynamic characteristics" for the arc shown in fig. 5.

The dynamic characteristics were first made use of by M. Blondel in 1891, and recently their use has been greatly extended by Dr. Simon. It will be seen that the chief difference lies in the behaviour of the arc while the current is *increasing* from zero to its full value. Another way of expressing this result is to say that the approximate resistance when the arc is starting in air is some 500 ohms, whilst in coal gas it is some 6,000 ohms. These diagrams have been called by Dr. Simon hysteresis loops, and in general—other things being equal—the greater the area enclosed the more efficient is the arc for the purpose of producing oscillations.

Effect of Addition of Transverse Magnetic Field.—The above experiments were repeated with no modification, save that the arc operated in a transverse magnetic field of about 3,300 C.G.S. units. The magnetic field at once produced the well-known two jets of greenish yellow flame, accompanied by the characteristic noise. In coal gas it was noticed that these two jets of flame were absent. These experiments were conducted in a mica-walled enclosure, through which coal gas was slowly passing, so that the arc could be inspected meanwhile. The oscillograms are shown in figs. 2 and 4, and the dynamic characteristics in fig. 6. On examination the effect produced by the magnetic field will be found to be small. Comparison of figs. 5 and 6 shows, however, that the characteristic in

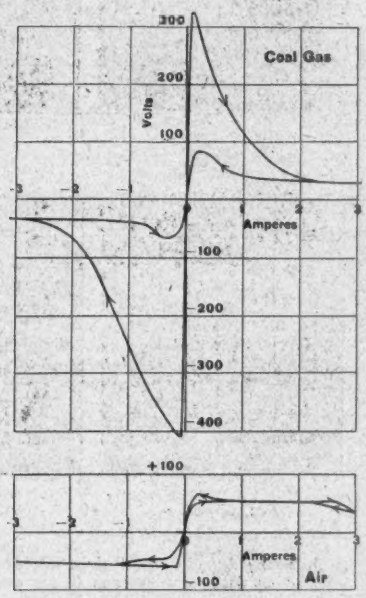


Fig. 5.—Without Magnetic Field.
Solid carbons, 12 mm. diam. Coal gas and air, 440 volts.
A.C., 60 ~, 1·7 amps.

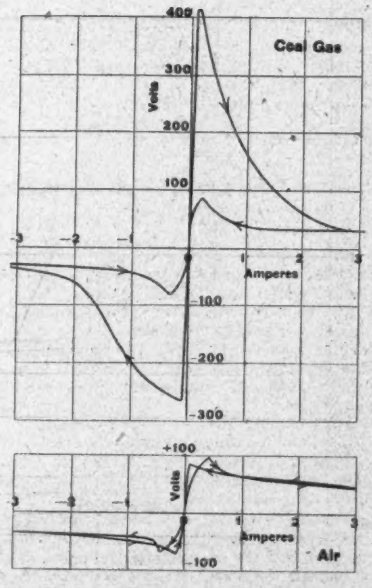


Fig. 6.—With Magnetic Field.
Solid carbons, 12 mm. diam. Coal gas and air, 440 volts.
A.C., 60 ~, 1·7 amps.

air with the magnetic field is steeper than when the field is absent. Further, that the average maximum voltage when the current is stopping is greater with a magnetic field than without.

Coal gas, no field	74 volts
„ strong field	83 „
Air, no field	61 „
„ strong field	77 „

Possibly this result may be explained by the fact that when the current is stopping the current-carrying part of the arc—being bowed—is longer, and, therefore, requires a greater voltage for the same value of current.

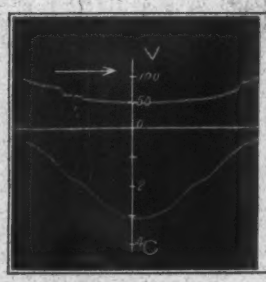


Fig. 7.—60 ~.

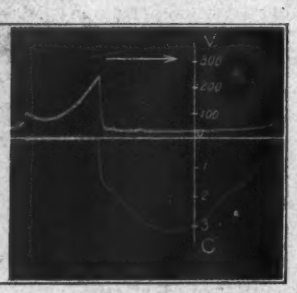


Fig. 8.—60 ~.

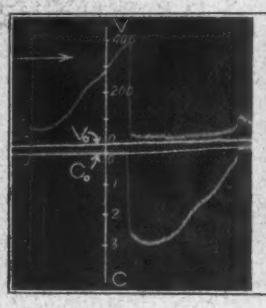


Fig. 9.—60 ~.

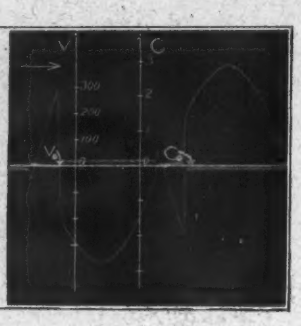


Fig. 10.—60 ~.

Pulsating Direct-Current Arcs.—Similar experiments have been carried out with solid carbons in air and with a copper positive pole and carbon negative pole in air and coal gas. Oscillograms for the copper carbon electrodes are given in figs. 7, 8 and 9, whilst fig. 12 shows the dynamic characteristics.

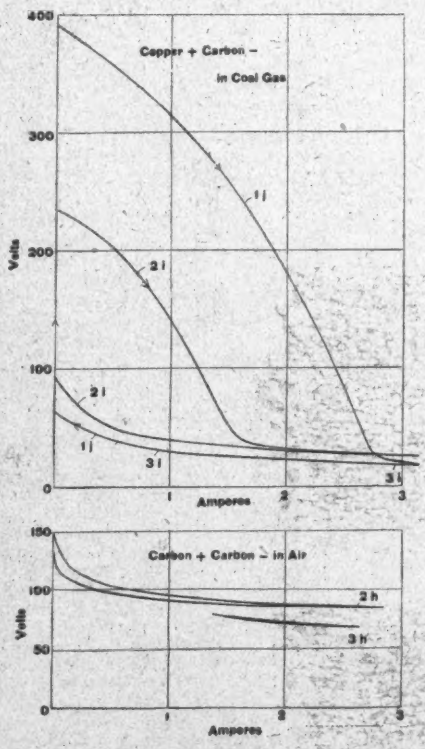


Fig. 12.—Pulsating Direct-Current Arcs.

240 D.C. + $\left\{\begin{matrix}120\\80\end{matrix}\right\}$ A.C., 1·7 amps. 3 i and 2 i without magnetic field. 1 j with magnetic field of 1,000 C.G.S. units.

The effect of the introduction of the magnetic field has been largely to increase the divergence between the characteristic for increasing and decreasing currents. As this result, however, is only based on a single experiment, too much weight must not be attached to it. At some future date the author hopes to be able to confirm this result.

Arc in Amyl Acetate.

In some experiments on which the author has recently been engaged on the production of Hertzian waves, he has used the oscillator of Langwitz, in which aluminium electrodes are used in paraffin oil, and has found that the substitution of amyl acetate for the paraffin oil is a considerable improvement. It therefore

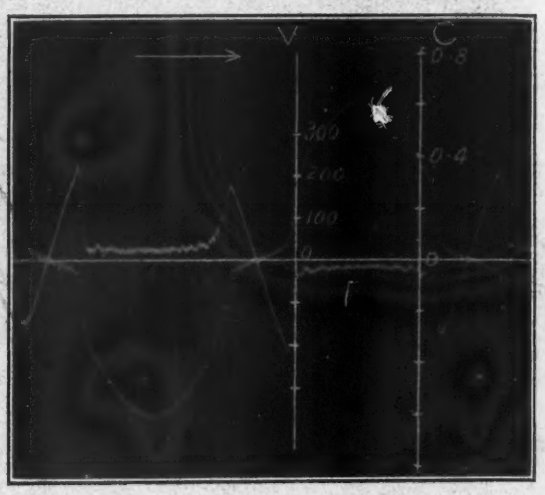


Fig. 11.—60 ~.

seemed of interest to conduct a set of experiments on arcs in amyl acetate between aluminium electrodes. Figs. 10 and 11 are oscillograms for the arcs on 400 volts alternating, fig. 11 being an arc ·02 of a mm., and fig. 10 an arc ·05 of a mm. in length. Their dynamic characteristics are shown in fig. 13, as is also the characteristic for a small pulsating current.

Duddell Arcs.

Comparative experiments in air and coal gas were attempted of the Duddell arrangement of an arc (shunting a D.C. arc with a capacity in series with an inductance) with copper positive and

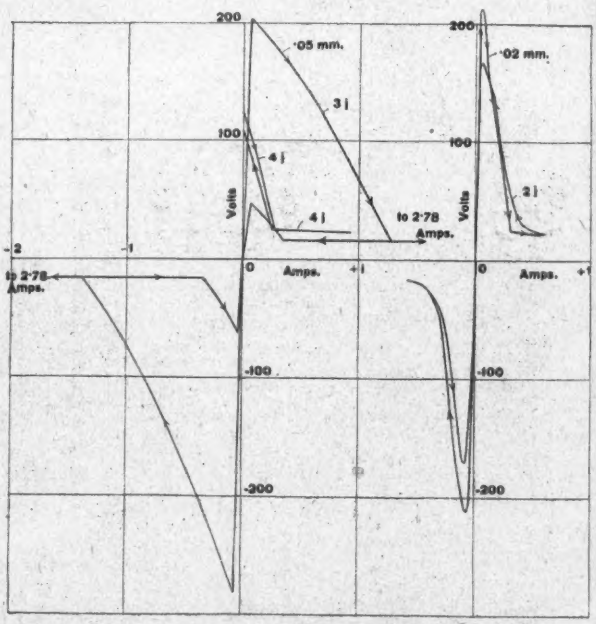


Fig. 13.—Electrodes: Aluminium, 6 mm. in Amyl Acetate.
400 volts A.C., 60 ~.
(4 j is for 240 volts D.C. + 112 A.C.)

carbon negative electrodes. Figs. 14, 15 and 16 are typical oscillograms obtained for coal gas. The collected comparative results of the voltage and the various currents are given in figs. 17 and 18, below which are also given the watt curves. "A" refers to quantities in the capacity inductance circuit, "B" to quantities in the arc itself, and "C" to those of the main circuit, "D" being the voltage on the circuit. The above mentioned effect will again be noticed (due to the introduction of coal gas) a higher value being attained by the voltage before the current rushes through the arc.

Further, it will be seen that the current in the arc itself is practically zero for half a cycle.

Production of Regular Pulsations in D.C. Arcs by means of a Magnetic Field.

For a long time past it has been known that when a D.C. arc is suddenly extinguished by the application of a transverse magnetic field, it goes out with what may be called an abrupt shriek or wail. This fact suggested to the author that the current through the arc was pulsating, and so after some preliminary experiments the following experiment was devised.

The previous horizontal arrangement of carbons was used, but in this case the carbons were bevelled on their upper sides at their extremities, so that the projection of each carbon in a vertical plane formed an angle of 40° from the horizontal. When an arc

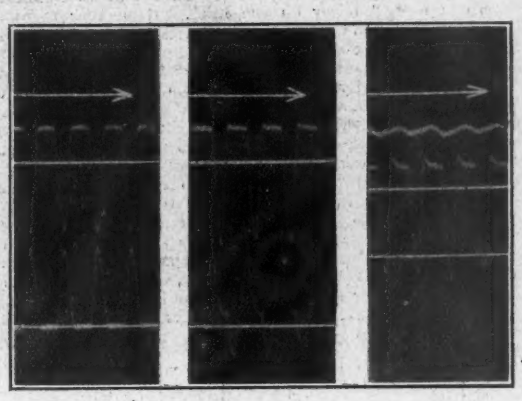


Fig. 14. Fig. 15. Fig. 16.

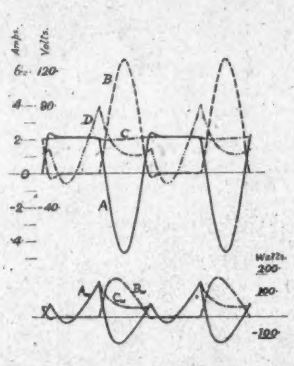


Fig. 17.—Copper-Carbon Arc in Air. Frequency 750 ~.

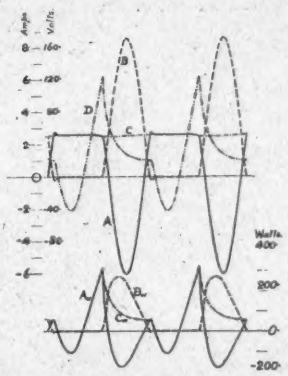


Fig. 18.—Copper-Carbon Arc in Coal Gas. Frequency 750 ~.

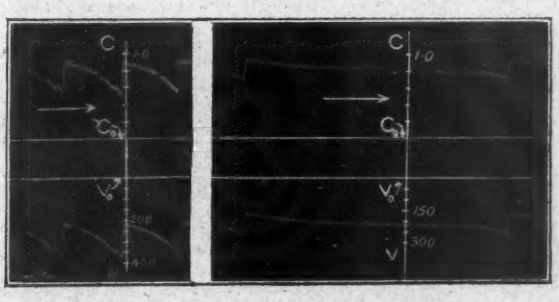


Fig. 20.—210 ~. Fig. 19.—57 ~.

was struck between these at a pressure of 480 volts D.C., having a non-inductive resistance in series, the current through the arc pulsated with a frequency which was higher, the stronger the magnetic field in which it was burning. Oscillograms of the oscillations are given in figs. 19, 20, 21 and 22 for approximate field strengths of B = 80, 120, 300 and 800 respectively, the frequencies produced being 57, 210, 1,800 and 4,300. These show a rapid rise in frequency with increase of field intensity.

Possibly, by correctly adjusting the field this action might be made use of to intensify the oscillation produced in an oscillatory circuit connected to it, but these experiments must only be regarded as preliminary. It should be noted that as far as the evidence in the author's experiments goes, it was not possible to preserve oscillations of constant frequency for more than half a minute at a time. An examination of the arc showed that on the positive pole, the arc formed a number of separate glowing spots in a vertical plane, while the negative electrode had a much shorter, but continuously, bright line. This effect was reversed when both poles and field were reversed.

It would appear that the production of these oscillations can be explained simply, if one considers the tendency of the arc to shorten, together with the fact that a curved arc in the magnetic field will require a greater voltage for the same current than a straight arc.

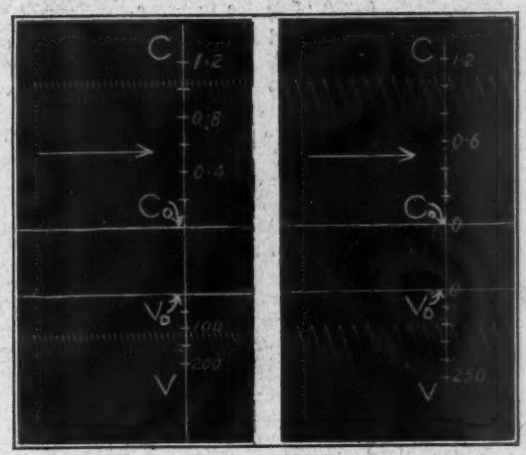


Fig. 22.—4,300 ~. Fig. 21.—1,800 ~.

It is conceivable that in some forms of circuit breakers, having magnetic fields which blow out the arc, that this oscillatory action might be distinctly dangerous, should the strength of the magnetic field not be properly proportioned.

The author cannot conclude without expressing his sincere thanks to Mr. A. G. Warren—a senior student of the East London College—for the valuable and painstaking assistance he has rendered in connection with these experiments.

LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names may be made. Answers are furnished by a barrister-at-law.*]

No. 101.—*Falling Telephone Wire.—Short Circuit with Trolley Wire.—Liability.*

"Orient" writes:—"Some friends of ours, who have been carrying on the public telephone service in one of the chief towns in India for the past 25 years under licence from the Indian Government, have asked whether we could furnish them with any information bearing on the following occurrence, and any advice which may be of use to them in connection therewith.

"It appears that electric tramways have recently been laid in the town in question, and that our friends' overhead distributing wires have, through no fault of theirs, now been converted into a possible source of danger through contacts with the trolley wires. A telephone wire recently broke, and falling across the trolley wire and thence on to two horses, killed both of them, and our friends are now threatened with an action for damages.

"As far as they are concerned, no harm could have resulted had it not been for the presence of the trolley wire, which was apparently unprotected, and has been installed long after their own wires had been in place; and these latter, of course, could never have been able by themselves to produce such an effect.

"We should, therefore, be much obliged if you could refer us to any legal work showing the position of the law in England on the subject, and on whom the responsibility rests in such cases; or of any information likely to be of use to our friends in this or any other similar incidents which may arise in future."

*** Applying the principles of English law to the above query, the telephone company would be held liable. The point was discussed some years ago in an English county court. A telephone wire fell across an unprotected cable belonging to a tramway company and carrying electricity at high pressure. In the result a horse was killed by an electric shock. It was held that the telephone company was liable, the accident having been caused through their negligence in allowing their wire to break. The law relating to electricity in India is practically copied from English statutes, and the law of negligence is virtually the same in both countries. "Orient" may find some assistance in Shiress Will's Law of Electric Lighting (3rd ed.), London, Butterworth & Co.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Length of Notice to Leave.

I read with interest the letter by "Aspirant" in your issue of July 26th. What a shame for an engineer to engage a shift engineer or assistant on the understanding of one month's notice before leaving! To think that any shift engineer can submit to have his career checked, and his hopes blighted, by being engaged on such terms (although having accepted his situation on these conditions), is simply preposterous.

I am hopeful that after "Aspirant" has read this he will again sit down and pen a few more lines; not in the nature of a letter to your "Correspondence" column, but his resignation, and that no time be lost in handing the same to his chief. This, from his own showing, is the only dignified step he can possibly take, in order that many Corporations may not be compelled in future to pass him by. Life is too short, and good appointments too few, for one with such abilities as "Aspirant" to remain in any situation requiring a four weeks' notice.

Now, Mr. Editor, be prepared next week for a shoal of advertisements under your "Situations Wanted" column, not forgetting to give the one from "Aspirant" every prominence.

Fairplay.

July 31st, 1907.

Want of Enterprise on the Part of British Firms.

We were recently appointed sole British buyers for machinery, material, boiler plates, tools, office fittings, &c., for one of the largest ship-building and general engineering firms in Italy, and a notice to this effect was put into almost every engineering paper asking firms desirous of doing business to send on catalogues.

We are naturally most anxious to do all we can to increase British trade, but are handicapped by the fact that only four firms had the enterprise to reply.

Is it surprising under such circumstances that the British manufacturer finds himself cut out by the more astute American or Continental rival, and then complains of bad trade and bad times?

J. C. Lyell & Co., Ltd.

London, S.W., *August 1st*, 1907.

The Electrical Trade.

Having carefully followed the discussion which has been conducted in your valuable paper on "The Present State of the Electrical Trade," and Mr. Ian Gorach's able article on "The Ethics of the Lowest Tender," in your issue of the 26th ult.; I hope I may be permitted to schedule a few points which might be considered worthy of attention by all the various units interested in the revival of the electrical industry, and when each individually feels inclined to shelve the question *sine die*, perhaps it would be well to have in reserve the undermentioned notes "for future reference" to stimulate him to continued action, without which no good end is attained. As one who takes more than a "passing" interest in this important question, it appears to me there is a chance of the usual result of such "disturbances," viz., a period of calm following the storm (of indignation, argument—call it what you like), as pointed out by Mr. Gorach.

Contractors.

Do take care that the supplier from whom you purchase your goods has a "permanent" address, so that when a breakdown occurs (through no fault of yours, of course) he can be found, and when found, see that you are in such a position that you are not knocked out with the argument—"Well, what can you expect for the price you paid?"

Don't save a few shillings on the first cost to lose a good many pounds on the subsequent maintenance, quite apart from the question of loss of prestige.

Do make a note of the fact that a responsible firm is willing to guarantee its productions, and so support you; at the same time, it wants a fair price for its goods, and naturally will not be made a plaything of those to whom prices have been quoted, by having its prices compared disadvantageously with others (fictitious or otherwise) with the object of cheese-paring.

Don't descend to questionable methods (although you may consider them smart) of trading. Be sure that when you are asked for a certain make of goods, you do not force another make on to your client, for the sole reason that "it is a trifle cheaper." Remember you stand a chance of losing your reputation with subsequent serious results to yourself by so doing (not to mention the by no means unlikely probability of your being involved in legal proceedings through misrepresentation).

Do make some gallant attempt to persuade your client, that cheapness in first cost, both in materials and workmanship, is not allied with efficiency and durability. Endeavour to knock the "cheap and nasty" bogey on the head. Remember there are plenty still willing to pay satisfactory prices (which allow a living profit) for sound work and best material.

Don't remain ignorant of new developments on the market, and find through your laxity, that your client is able to teach you the business *you* should know—and be able to enlighten *him* upon.

Do bear in mind that you have the right of free speech, and when you have something good to talk about (which you should have if you know your business) silence is not always golden.

Don't be made a medium for using up a firm's old stock lines in return for long credit, so retarding your progress.

Do pay attention to the fact that your clients are eager to have some novelty—for instance, in lighting—to show their friends the added convenience electricity allows over gas, and being satisfied they become your best advertising mediums, as who is better able to do extension work or similar lighting in houses of the clients' friends than the contractor who was so successful in the original instance?

If you don't give the above points your best and active attention, remember that the result will be that the intelligent student with his eyes open now passing through our technical colleges, will in time wipe the present-day contractor out of the running altogether.

Manufacturers (British).

Do remember that you after all are the prime factors in the revival of the electrical industry. Aim at efficiency in manufacture at fair trading prices. Let "Something new and good" be your motto.

Don't follow suit with your foreign rivals just because "cheap and nasty" is at present the order of the day. Don't trade on the policy of "just to keep the works going," but remember that the more you do this, the firmer the foothold you are giving your rivals.

Do be aware of the fact that there are consulting engineers and contractors, and if you make an effort to make the path of the former as easy as possible in the mutual interests of the community, by seeing that they have something good to popularise, don't encroach upon the preserves of the latter.

Don't be deceived by the contractor who poses also as a wholesaler in order to get improved terms, and so place himself at an advantage over his *bona fide* confrère. This system requires drastically stamping out.

Consulting Engineers.

Don't have too many "fads," and let those you have be good ones and not such as to narrow down the electrical trade to the point of mediocrity.

Do make yourselves acquainted with the very latest on the market, so that you may be in a position to guide your social and contracting friends.

Remember that combination amongst yourselves, both in ideas and mode of procedure, is essential to fight the competition of gas (a point which has lately received great attention from the gas engineers).

Don't forget that you can make the path of the contractor pleasant or unpleasant according to your inclination to be reasonable, therefore

Do support him (*i.e.*, when you are assured of his *bona-fides* as a competent and enlightened individual) by allowing him latitude of action, as he, if an admittedly experienced man, is equally anxious with you for the success of an installation.

Supply Company Engineers.

Do bear in mind that the contractor is only human.

Don't endeavour to take away his living by ousting him altogether from the field of operations.

Do pull together and, by all means, adopt the new rules of the Institution.

Don't stand on your own pedestal quite so firmly.

One and All.

Do keep up your spirits.

Don't get downhearted.

Allowing that you may have had some inducement through the recent continued period of bad weather to look upon the present hard times with a somewhat pessimistic eye; yet, as we are now experiencing brighter times, as far as the weather is concerned, let us have a corresponding enlivenment of our natures, tonicked by the remembrance that

after all we are Britishers, not gifted to take a beating lying down, and always determined to overcome the foreigner, whatever methods he may adopt. Keep up your end, and I am sure you will bring about the revival of the electrical trade in Great Britain, and also Greater Britain, so far as we Britishers are concerned.

Redivivus.

"Emissary."—A correspondent wants the address of the makers of Thompson's commutator lubricant bearing this mark.

LEGAL.

Liverpool District Lighting Co., Ltd., *v.* Newall, Harrop and Gibson.

Before Judge W. F. K. Taylor, K.C., in the Liverpool Court of Passage on August 2nd, the Liverpool District Lighting Co., Ltd., sued Newall, Harrop & Gibson, for damages for breach of agreement.

For the plaintiffs, Mr. Greer stated that his clients had a prov. order for the supply of electricity in and about the neighbourhood of Liverpool, and as a convenience to customers they put in installations on the free-wiring system, the consumer undertaking to pay as rent 1d. per unit above the ordinary charges for energy. By the agreement, the landlord undertook on the sale or letting of the premises to require that the purchaser or the tenant should either ratify the agreement or permit of the installation being removed. In this case, on the premises being sold, the purchaser refused to ratify the agreement or to allow the removal of the installation, which he claimed to be his property.

For the defence it was stated that defendants had given plaintiffs permission to remove the installation before the transfer of the property, but the plaintiffs had not immediately availed themselves of it. It was also contended that the agreement was signed on the understanding that there would be no pecuniary liability to the owners, and that during the five years the installation had been in the cost had almost been paid off.

Judgment was given for plaintiffs for £20.

Electrical Apprentice Action.

At Brentford County Court on Friday, before His Honour Judge Howland Roberts, Hy. Breckley, of Hounslow, sued Messrs. Day and Hayes, electrical engineers and contractors to the Heston and Isleworth District Council, of High Street, Hounslow, and The Poplars, Bath Road, Hounslow, for £20 premium paid on apprenticeship indentures.

Mr. Wilfrid Firth was for the plaintiff, and Mr. H. Hart for the defendants.

According to the former, the plaintiff apprenticed his son, who desired to learn the electrical engineering business, to the defendants, who were considered a responsible and capable firm. The lad was with them some little time, but learned nothing, and then there was a dissolution of partnership, which still further upset his prospects. As the firm was broken, plaintiff considered that that put an end to the indentures, and he sued for the premium he paid. The lad was called, and stated that he learned nothing at all of the business except on rare occasions. He admitted that he had been employed on some of the firm's electrical jobs, but it was to fetch and carry material.

Mr. Hart submitted that, as the partnership was at an end, the action must fail as against the firm. As to the individual liability, if any, it should fall on the defendants in equal shares, but he contended that the plaintiff's son had been given instruction in the elementary portions of the business.

His Honour held that, as the firm had been dissolved, action would be only against Mr. Hayes, who had signed the indentures. He dismissed the action as against Mr. Day, and found for the plaintiff as against Mr. Hayes for £13 6s. 8d., being two-thirds of the premium.

Petition for Revocation of Patent.

The hearing was resumed before Mr. Justice Parker of the petition for revocation of the patent No. 14,006 granted to Mr. J. N. Alsop, an electrical engineer, for a process of bleaching and purifying flour and increasing its nutritive properties by subjecting it to the action of air which had previously been subjected to the action of an arc or flame of electricity. (See Elec. Rev., July 26th, p. 129.)

Mr. A. J. Walter, for the petitioners, said it was admitted that the process did not increase the nutritive properties of the flour, and contended that if a patent did not do one or more of the things claimed, it was bad. The respondents had sought to amend by striking out the whole body of the specification dealing with the effect of the process in increasing the proteids, but the patent would never have been granted if it had been explained that it was for two inventions which could be separated, one for bleaching the flour with oxides of nitrogen, and the other for increasing the proteids. The patentee did not say how the effect of bleaching was produced. There was no detail, and there was nothing as to the voltage or the amperage of the current. The patentee stated as the fundamental basis of his process that he produced a gas of which he did not know the composition. On the face of it, the specification looked as if some great discovery had been made, but the whole foundation of the letters patent that he sought and the grant that he obtained was that he had discovered a new means of producing proteids and diminishing the starchy compounds. It was to do that and incidentally to bleach that the letters patent were taken out. The patentee now desired to say that the process would be the same as that which he designed, although it did not alter the chemical composition of the flour. When a patentee drafted a specification by appealing to the unknown and the mysterious he must take the burden of it.

Mr. Justice Parker, in giving judgment, said that if a patent was taken out for a result which could not be produced, the consideration failed, and if it was for a process producing two results, and only one was in fact produced, the consideration partially failed. On that ground the patent in this case was invalid. The gases produced by a disruptive discharge of electricity were according to the evidence NO, a trace of ammonia, and if copper electrodes were used, a slight trace of ozone. The NO on contact with air was partially oxydised, making NO_2, N_2O_4, N_2O_3, and if the air contained vapour, a little nitric acid. If copper electrodes had been used, there might be yet another oxide, NO_3. The trace of ammonia was so slight, that it might be ignored, and the specification did not insist on copper electrodes. The gaseous medium, therefore, consisted for practical purposes of four oxides of nitrogen, with a little nitric acid, the whole diluted in air. NO if used alone certainly did not bleach flour. NO_2, N_2O_4 and N_2O_3 certainly did, and nitric acid did, if not directly, at any rate by reason of the production of nitrogen peroxides when it came in contact with atmospheric air. NO_2, N_2O_4, N_2O_3 and nitric acid were all oxides of nitrogen producing nascent oxygen, and their use in air for bleaching purposes was, therefore, expressly disclaimed. They had, therefore, this curious result that the patentee claimed a process of bleaching by the use of five constituents diluted in air, four of which would bleach flour, and were disclaimed, while the other had no bleaching effect. The gaseous medium was practically the same as that produced under Andrews's specification, and there was no subject matter for a patent in producing it electrically, instead of chemically. It had been suggested that he should give leave to further amend the specification, but he thought no amendment which could be made would obviate the defects in the patent.

The petition was therefore granted, with costs.

BUSINESS NOTES.

Bankruptcy Proceedings.—Garrick Electrical Co.—At Wolverhampton Bankruptcy Court on July 31st, the examination took place of A. H. Dodd and H. J. A. Whateley, trading as the Garrick Electrical Co., Walsall Street, Bilston, and formerly of Wolverhampton. The partnership account shows liabilities amounting to £36 9s. 1d.; assets, £10 18s. 11d.; and a deficiency of £20 16s. 7d. In the case of A. H. Dodd, his private liabilities are £14 4s. 6d.; and in the case of Whateley, £14 2s. 4d. The latter stated that up to May, 1906, he was a journeyman electrician, and in that month he went into partnership with Dodd, each providing £10 capital. They equally divided the profits, and they filed the petition owing to an execution for a debt of £6 3s. 3d., due for electrical goods supplied. The examination was closed.

F. E. Williams, electrical engineer, Coventry Road, Birmingham (F. E. Williams & Co.).—First and final dividend of 10½d. in the £, payable August 12th, at 191, Corporation Street, Birmingham.

Annual Outing.—On Saturday, August 3rd, the Chloride Electrical Storage Co., Ltd., held their employés' picnic at Morecambe. The works at Clifton Junction were closed as far as possible for the day, and the party presented a goodly muster of men. They journeyed to Morecambe by an early train, and on arrival breakfast was partaken of at the King's Arms Hotel; afterwards conveyances were in readiness for a delightful drive, covering some 18 miles through Halton and Caton, and returning to the King's Arms Hotel for dinner, which was presided over by the general manager of the company (Mr. W. S. Naylor). A novel badge was worn by the men, consisting of a white-metal miniature of the company's well-known "R" type plate suspended by red and black silk ribbon.

Stirling Boiler Orders.—The Stirling Boiler Co., Ltd., have recently received orders for one pair of boilers for the India State Railways (repeat order); two boilers with superheaters and economiser for the Buenos Ayres and Pacific Railway Co.; four boilers fitted with chain-grate stokers and superheaters for the Corporation of Copenhagen's new electricity works; four boilers and stokers for the Compagnie L'Union des Gas, Milan; eight boilers to be fired with blast furnace gas, for a northern firm, and many others.

Turbines and Reciprocating Engines Combined.—The White Star and Dominion Lines have adopted for their new steamer *Adriatic* the system of quadruple-expansion engines (two sets), working in conjunction with one low-pressure turbine, each of the three engines having its own shaft and propeller.

A Belgian Contract.—The Belgian subsidiary company of the Felten & Guilleaume-Lahmeyer Works, of Frankfort-on-Maine, has obtained a contract from the city of Brussels, in connection with an extension of the municipal electricity works, that was thrown open to international competition. The contract comprises an A.C. turbo-generator of 5,000 KW. at 5,000 volts and 1,500 R.P.M., the turbine being of the Zoelly type made by the firm of Escher, Wyss & Co., of Zurich. In addition to this, the contract includes condensing plant for the turbine, together with electrically-driven pumps, steam mains and mechanical and electrical regulating and measuring equipments.

Dissolutions and Liquidations.—Messrs. Hansard and Watson, of Parliament Mansions, Victoria Street, Westminster, S.W., announce that they have dissolved partnership as from August 1st. Mr. Arnold G. Hansard, B.A., M.I.E.E., will carry on the business under his own name, and will be responsible for all debts of the late firm.

Siemens Electric Appliances, Ltd.—This company is winding up with Mr. A. M. Hicks, 8, Belmont Road, Wallington, Surrey, as liquidator. Creditors must send particulars of their debts, &c., by September 30th.

Automatic Light Controlling Co., Ltd.—A meeting is to be held at Westover Chambers, Bournemouth, on September 9th, to hear an account of the winding up from the liquidator (Mr. John Gunning).

Trade Announcements.—Pending the erection of a factory for metal filament lamps in England in conjunction with the General Electric Co., Ltd., of 71, Queen Victoria Street, London, E.C., the Deutsche Gasgluehlicht Aktiengesellschaft (Auergas.), has placed the sole sale of its "Osram" (tungsten) lamp for Great Britain and Colonies in the hands of the above company.

The electrical engineering business carried on at Maidenhead, Berks., by Messrs. Holman James & Co., Ltd., has lately been strengthened by the addition to the board of Mr. Jno. Budgen, J.P., of the firm of Messrs. J. Budgen & Co., ironmongers, High Street, Maidenhead, who has taken a large financial share in the company, and will be chairman in future. Mr. Holman James will be retained by the company as managing director.

Mr. J. B. Windson, A.M.I.E.E., has opened an electrical engineering business at 2, Town Hall Square, Portsmouth.

Catalogues.—Messrs. Watts, Fincham & Co., Billiter Buildings, London, E.C.—Booklet relating to "Slyp-not," a dressing for belts and ropes which is free from resin and mineral oil, and renders belts waterproof.

Messrs. Dick, Kerr & Co., Ltd., Abchurch Yard, E.C.—Brochure describing the Thury system for long-distance transmission of power by direct current. The leading features of the system are explained, with numerous illustrations, derived mainly from the Moutiers-Lyons installation, where 4,320 KW. are transmitted 112 miles at 57,600 volts (see Electrical Review, August 10th, 1906, page 219). Exhaustive tests have shown that a pressure of 150,000 volts D.C. can safely and practically be employed with overhead wires, and the pamphlet draws attention to the simplicity and cheapness of the system. A list of 16 existing installations working at various pressures is given.

Horsfall Destructor at Dunoon.—This destructor, which was completed and set to work last autumn, has recently undergone a test of 58½ hours' duration to ascertain its capacity in the burning of refuse, and the raising of steam. The plant tested consists of two Horsfall standard back-feed cells with forced draught furnished by means of steam jets on the Horsfall patent hot-blast system. The boiler is of the Babcock & Wilcox "Marine" type, and there is a Green economiser of 48 tubes.

The refuse of a summer health resort is probably at its worst from the destructor point of view at this time of the year. The quantity of refuse burned proved on the test to be 12 tons per cell per 24 hours, against 10 tons guaranteed, and the evaporation proved to be 1·33 lb. of water per lb. of refuse from and at 212° F., against 1·25 lb. guaranteed. The percentage of clinker and ash to refuse burned was 23 per cent., and the temperature in the combustion chamber was maintained at over 2,000° F. The power developed by the two cells works out at about 118 I.H.P.

LIGHTING and POWER NOTES.

Abram.—The *London Gazette* contains notice of the U.D.C.'s intention to transfer its prov. order to the Lancashire Electric Power Co.

Aspull.—The *London Gazette* contains notification of the intention of the U.D.C. to transfer its 1901 electric lighting order to the Lancashire Electric Power Co.

Bridgend.—The U.D.C. has decided to apply for a prov. order for E.L., the area of supply to include Newcastle Higher, Coity Higher, and Gwenny in the district of the Penybout R.D.C.

Bristol.—The L.G.B. has sent to the T.C. sanction for a loan of £2,335 for wages of permanent workmen. The sum was deducted from a loan applied for last September.

The Electrical Committee has reduced the price of energy for advertising signs, &c., from 4½d. to 3½d. per unit.

Clayton-le-Moors.—The U.D.C. has appointed a Committee to confer with representatives of the Church and Oswaldtwistle U.D.C.'s with reference to the application of Accrington T.C. for a prov. order for E.L.

Croydon.—It is reported that an agreement has been entered into to supply the County of London Electric Supply Co. with electricity in bulk from the Corporation's generating station, at prices ranging from 3d. to 2½d. per unit.

Electrically-Driven Scotch Rolling Mills.—An extensive electrical equipment has recently been completed at one of the rolling mills of the Motherwell Iron and Steel Co., Ltd. The plant, supplied and erected by the Electrical Co., Ltd., consists chiefly of two trains, namely, the roughing and finishing mill, driven by one motor direct coupled; and the hard rolls, driven by one motor by means of belt. Energy will be taken from the Clyde Valley Power Co., the supply being three-phase current at 2,000 volts, 25 cycles, and at 400 volts, 25 cycles. Both trains are to run continuously in one direction; for the roughing and finishing mill a motor having a normal output of 500 H.P. at 140-110 R.P.M. is installed, and the hard rolls are driven by a motor having a normal output of 150 H.P. at 485 R.P.M. The material rolled will be iron and mild steel, and the output about 25 to 50 tons per 12 hours, according to the material rolled. For starting and controlling the motors, special liquid starters with automatic regulators and switchcases with the necessary instruments are provided. In addition to these two rolling mill motors, seven small motors for auxiliary machines are installed for 400 volts, 25 cycles. The motors and a lighting transformer, which transforms the current from 400 volts down to 115, are connected to a main distribution board, which is placed in a room underground.

Finchley.—The report of Mr. A. H. Preece on the electricity undertaking has been considered by the Council. The report is generally in favour of the undertaking, and recommends the Council to borrow £12,000 for extensions of plant, and £10,000 for mains extension, which sums it was agreed to apply for.

India.—Messrs. Killick, Nixon & Co. have applied for electric licenses for power, traction and lighting in Ahmedabad, Poona and Karachi. It is proposed to supply continuous and alternating current of high or low pressure as required. As regards the first-named place, it is expected that the cotton mill-owners will largely adopt electric driving in the numerous mills in the district.

Kingston-on-Thames.—The T.C. has reduced the price of energy for motors, cooking, and heating from 2d. to 1½d. per unit, and has decided to allow tradesmen a discount of 25 per cent. for energy used in charging accumulators.

Llanelly.—The U.D.C. has decided to inform the Llanelly E.L. and Traction Co. that it will be willing to purchase 50,000 units per annum when a supply is available, but without prejudice to the rights of the Council.

London.—Natural History Museum.—Mr. Harcourt, First Commissioner of Works, recently stated that the work of introducing electric light into the Natural History Museum, South Kensington, was gradually being proceeded with, and an instalment of the provision was taken in this year's estimates.

Stepney.—At a special meeting of the B.C. held on July 24th, it was decided by 31 votes to 1 to proceed with the Blyth's wharf extension scheme, under the supervision of the borough electrical engineer.

Islington.—A report and recommendation by a special Committee, that the large scheme of arc lighting, embarked on and partly carried out by the previous Council, should not be further proceeded with, has been adopted by the B.C. Some £10,000 worth of material is on order, but not yet delivered, in connection with this scheme.

Hampstead.—The B.C. has agreed to purchase special transformer gear, which it has had on trial for some time, from the British Electric Transformer Co. The apparatus consists of a 75-KW. and a 7½-KW. transformer, with apparatus for automatically cutting in or out the large transformer when the load is above or below the capacity of the smaller one. The apparatus proved very satisfactory.

Manchester.—The town clerk has been instructed to prepare agreements, under the corporate seal, for supplies of electricity, for a term of years, with the following firms, namely, Electromotors, Ltd., Mr. Joseph Stubbs and Sir W. G. Armstrong, Whitworth & Co., Ltd.

Motherwell.—The income of the electricity department for the year ending May 15th last, amounted to £10,139, and after deducting working and financial charges, leaves a net profit on the year of £730. Some 1½ million units were sold, representing a 30 per cent. increase, the cost of production being ·68d. per unit; the equivalent 8-C.P. lamps connected were 74,464; and the units sold for power purposes, 793,000.

Neath.—The R.D.C. has decided to purchase plant from the South Wales Electrical Power Distribution Co. at Court Sart, Neath, for the development of the Council's E.L. scheme, for £7,000. The station, with its equipment, originally cost over £42,000.

Sowerby.—The P.C. has accepted the tender for public lighting of the Northern Counties Electric Supply Co., at 27s. 6d. per lamp. The Thirsk Gas Co. submitted a competitive tender.

Stretford.—A L.G.B. inquiry was held on July 30th relative to the application of the U.D.C. for a loan of £53,460 for electricity purposes. The only opposition was from a Councillor, who wrote alleging that the undertaking was "a hopeless concern," and suggesting that before more money was borrowed the advisability of arranging for Manchester to take over the works should be considered. The clerk to the Council (Mr. G. Abrahams) said that the undertaking had been successfully managed without incurring any charge whatever on the rates. The present loan, he added, would meet requirements for five or seven years at least. The inquiry was adjourned.

Surbiton.—The B. of T. has approved of the agreement between the B. of T. and Messrs. Callender for the establishment of electric lighting.

U.S.A.—On the 15th of this month the Niagara Falls will be illuminated by electricity for the first time. About 50 large searchlights will be employed with a new attachment for creating scintillating colour. The searchlights will be located below the Falls, and in this way the whole of the splendid spectacle will be shown illuminated. It is hoped that the coloured light, when flashed in the air, will be visible as far as Toronto.

TRAMWAY and RAILWAY NOTES.

Accrington.—Mr. Reginald Page Wilson, the B. of T. arbitrator relative to the purchase of the engines and cars of the Tramway Co. by the T.C., has given his award. On the scrap value basis he places the value at £1,115, and on the landlord and tenant basis at £2,490, the Council to have the option of either basis, with costs against the Tramways Co. The company asked £8,389.

A portion of the new electric tramway system, extending to Oswaldtwistle, was opened on August 2nd.

Aldershot.—The Light Railway Commissioners have notified the local authorities that they have granted the Aldershot, Farnborough, and District Light Railway Order.

Barking.—The Ilford Council has declined to agree to inter-running as a basis of future negotiations in regard to the working of the Council's light railways. It has been decided to terminate the existing agreement with Ilford in regard to tramways in East Street and Longbridge Road.

Blackburn.—Owing to building operations on the route, a large elm tree, which was rendered unstable, fell over the track of the Corporation tramways last week, breaking the trolley wires and bending the bracket arms. Traffic was interferred with for a considerable time.

Continental Notes.—SWITZERLAND.—It was announced at the last meeting of the Administrative Council of the Swiss Federal railways, that the experience gained in the electric haulage of trains in the Simplon tunnel had been completely satisfactory, and that the introduction of electrical working on the section Iselle-Domodossola would follow shortly. On account, however, of the great importance of the question of electric train working, it is impossible to draw a final conclusion as to the period for the general adoption of this method of locomotion. A decision has also not been arrived at in regard to the experimental institution of electric traction on certain other sections of the Swiss Federal Railways, which work is to be entrusted to Swiss electrical firms. Nevertheless, the work on these particular lines, the most important of which is that between Zurich and Lucerne, which is to be given to the Oerlikon Machine Works, has by no means been postponed indefinitely. The negotiations with the electrical firms have not yet been concluded, but it will not be longer than a period of two years before further sections of the Swiss railways will be equipped for electrical working, and electrical firms afforded an opportunity of demonstrating the advantages of their respective systems.

SPAIN.—La Sociedad de Los Tranvias de Zaragoza has applied for a concession to construct and work another line of electric tramway in the town.

The *Gaceta de Madrid* of July 18th notifies an application by the Compania Anonima de Tranvias de Barcelona for the concession for an electric tramway from Barcelona to San Andrés.—*Board of Trade Journal.*

ITALY.—A demand for a concession for an electric railway from Brescia to Caffaro will shortly be submitted for the approval of the Council of Public Works, the estimated cost being £200,000.

Croydon.—The B.C. on the recommendation of the Tramways Committee has decided to take out an additional insurance policy to cover the Council to the extent of £5,000 per accident.

Dartford.—A conference has taken place between Messrs. J. G. White & Co. and the U.D.C. respecting a proposed extension of the lease of the light railways; the committee recommended that no deviation be made in the existing agreement.

Dundee.—Now that the Royal Assent has been granted to the new Corporation Bill, the work of extending the city tramways to Downfield and the railway stations is to be proceeded with at once. It has been decided that the erection of the overhead equipment shall be done by the Electricity Department employés, and it is estimated that the cost of the whole work will amount to about £10,000.

Liverpool.—The new headquarters of the city tramways department in Hatton Garden was opened on August 2nd. On the completion of the opening ceremony, the party visited the Lister Drive power station, travelling in decorated cars.

The City Council has agreed to pay the representatives of the late Mr. Bellamy (general manager of the tramways) the sum of £500 in respect of the various devices patented by him and used by the tramways department.

London.—The Board of Trade are about to constitute a special temporary branch for the purpose of dealing with matters relating to London traffic, so far as they come within the scope of the Board. The branch will be under the direction of Colonel Sir Herbert Jekyll, K.C.M.G., now assistant secretary in the railway department. The president has appointed Mr. George Ranken Askwith to be assistant secretary in the railway department, in succession to Sir H. Jekyll. The president has further appointed Mr. J. G. Willis to be a junior assistant secretary in the railway department.

Maidstone.—The B. of T. has informed the T.C. that it has confirmed the application for powers to extend the electric tramways to Tovil *via* King Edward Road, to which there was opposition on the part of property owners, and also a branch line on the Loose route *via* Mill Street and Knightrider Street.

Manchester.—The Tramways Department is proposing to build another large car-shed on the south side of the city. The matter is in the hands of a sub-committee, which has been given power to negotiate with the owners of the site.

Middlesex.—The Light Railway Commissioners have granted the London United Tramways Co. two years' extension of time in which to commence its light railways from Hounslow to Hanworth, from Twickenham to Hanworth, and along the Staines Road to Staines.

A conference was held last week at Ealing on the invitation of the T.C. to consider the noise nuisance caused by the London United Co.'s trams. Representatives from Ealing, Twickenham, Teddington, Hampton and Chiswick were present, and the subject was discussed at length. It appeared from some correspondence with the Teddington Council, that the Board of Trade took the view that it had no power to intervene until some of the aggrieved authorities had taken proceedings before the local justices to stay the noise complained of. Exception was taken to this contention, and it was resolved to ask the Board of Trade if its ruling was final. If it were, the conference thought that action should be commenced against the tramway company in one of the local police courts, with a view to having a case stated for the Divisional Court.

Musselburgh.—A strike of the local company's tramway employés has occurred, and many of the cars have been damaged by the strikers. A reduced service is being carried on under police protection.

Northampton.—The T.C. has decided in favour of extending the electric tramways to Far Cotton, at an estimated cost of £13,540.

TELEGRAPH and TELEPHONE NOTES.

Australian Cables.—According to the *Singapore Free Press*, all three cables on the Eastern Extension system between Banjowangie and Australia successively broke down at the end of June, interrupting the direct Australian route, though there were still two alternative routes. About 17 years ago a similar triple breakdown occurred, isolating Australia absolutely for some days, with the result that the military forces were hastily mobilised, under the impression that an armed invasion was about to take place.

Automatic Telephones in Germany.—The Gesellschaft für Automatische Telephon (Automatic Telephone Co.) has just been formed at Berlin with the participation of the Siemens and Halske Co., Ludwig Loewe & Co., and the German Arms and Ammunition Co. The object of the company is the promotion of the use of the Strowger patents for automatic telephony. No working capital is proposed, as the Siemens & Halske Co., which has undertaken the manufacture and sale of automatic telephone exchanges, has to provide the working capital according to agreement.

Johannesburg Telephones.—Great improvements have recently been effected in the trunk telephone communication between Johannesburg and Pretoria. The existing lines have been reconstructed, and eight additional wires have been erected,

making 32 in all; these form 16 circuits, of which 15 are open to public use. H-poles have been used throughout, and provision has been made for 16 wires in addition to those already installed.

London Telephones.—Arrangements have been made between the Post Office and the National Telephone Co. to simplify the transfer in 1911, and to avoid duplication of plant. The London area will be divided up between the two systems, and each section will be developed exclusively by one or the other. The Bank exchange will be abolished, the subscribers being connected instead with the London Wall National exchange or the Central exchange of the Post Office, and similar arrangements will be made elsewhere, only the up-to-date exchanges of the company being retained.

New Cables.—The new cable between New York and Colon *vid* Cuba of the Central and South American Telegraph Co. was opened for traffic on 1st inst.

The *Journal Télégraphique* states that the following submarine telegraph cables have been opened for service, viz., between Valdez and Ft. Liscum; Juneau and Haines Mission; Haines Mission and Skagway; Cape Fanshaw and Wrangell; Wrangell and Hadley; and Hadley and Ketchikan. The Russian Government has granted a concession to the Great Northern Telegraph Co. for the laying and working of a new cable between Russia and Denmark, between St. Petersburg and Libau, and Libau and Möen or Själland.

Telegraphic Interruptions and Repairs:—

Cables.		Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed..	Jan. 12, 1906 ..	..
Reissa-Issa and Reissa-Yemani (Yemen) ..		Oct. 22, 1902 ..	..
Tarifa-Tangier		Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)		Mar. 9, 1904 ..	..
Garachico-Santa Cruz		July 12, 1906 ..	..
Las Palmas-Arecife		Aug. 18, 1906 ..	..
Brest-Dakar		July 22, 1907 ..	..
Gibraltar-Tangier		July 29, 1907 ..	..
Landlines.			
Puerto-Barrios		Aug. 2, 1902 ..	..

Wireless Telegraphy.—The absence of regulations in the United States regarding wireless telegraph installations is causing some trouble and interference between various systems, the one belonging to the Government at Washington being the chief sufferer. A young man living in the neighbourhood has set up a system of his own, and amuses himself by interfering with the transmission of official messages to coast stations and warships. The police have declined to interfere.—*Electrical World.*

It is reported that a message was recently received at the Steglitz Station, near Berlin, of the Amalgamated Radio-Telegraphic Co., Ltd., from the ss. *Hellig Olav*, when that vessel was over 2,000 miles distant in mid-Atlantic. This, it is claimed, is the record distance from ship to shore.

Wireless telegraph stations are to be installed at the Arabian ports of Kugfonda and Hodeida, on the Red Sea.

Vienna Telephones.—Enormous extensions of the telephone system are to be carried out, raising the capacity of the exchanges from 23,000 to 100,000 subscribers, and increasing their number from two to nine.

CONTRACTORS' COLUMN.

Openings for New Business.

BANGOR.—New University College of North Wales. J. E. Lloyd, M.A., secretary and registrar of the College, Bangor.

BARNSLEY.—High School for Girls. Buckland & Haywood-Farmer, architects, Norwich Union Chambers, Congreve Street, Birmingham.

BARNSTAPLE.—Offices for *Western Morning News*, High Street. Messrs. Cooke, builders, Bear Street, Barnstaple.

BELFAST.—Large shed at harbour, to be constructed for Harbour Commissioners.

BELFORD.—Grey Memorial Nurses' Home. J. Stevenson & Son, architects, Berwick-on-Tweed.

BIRKENHEAD.—Hospital for the B.G. E. Kirby & Sons, architect, 5, Cook Street, Liverpool.

BLACKPOOL.—Extension of Corporation baths (£60,000). Borough engineer.

BLAYDON-ON-TYNE (Winlaton).—Ten houses for Blaydon Co-operative Society.

BOLTON.—Extensions at Messrs. Hesketh's Astley Bridge cotton mills. J. H. and G. Marsden, builders, Bridge Street, Bolton.

New branch for Bolton Co-operative Society at Astley Bridge. E. and W. Murgatroyd, builders, Bow Street, Bolton.

BOURNEMOUTH.—Block of 15 houses and shops in Southbourne Grove. S. Brown & Sons, builders, Queen's Road, Bournemouth.

Business premises. J. J. Allen, Ltd., The Quadrant, Bournemouth, owners.

BRIDGEND.—New west and east wings at Court Colman for R. W. Llewellyn. Cook & Edwards, architects, Masonic Buildings, Bridgend.

BRISTOL (Bedminster).—New Council school (£12,960). E. Walters & Son, builders, 3, Richmond Road, Bristol.

Electricity sub-stations at Hotwells, Cowper Street, and St. George's (£1,563). R. Wilkins & Sons, builders, 20, Bishop Street, Bristol.

CANTERBURY.—Important extensions to the Post Office to be wired. John Shelbourne & Co., builders, High Street, Wandsworth, and 70, Fenchurch Street, London, E.C.

CARDIFF.—New secondary boys' school for the T.C. (£10,000 to £13,000).

Block of offices. Henry Bugden, architect, 95, St. Mary Street, Cardiff.

CHELMSFORD.—New Post Office (£5,500). W. E. Blake, builder, Salisbury Road, Plymouth.

CHESHIRE.—Large Asylum extensions at Upton and Parkside for the C.C., to cost £150,000.

CHESTERFIELD (Bolsover).—New church. Collis & Son, builders, Chesterfield; Rollinson & Son, architects, Chesterfield.

CHICHESTER.—West Sussex Secondary School (£12,350). H. P. Roberts, architect, Horsham.

COATBRIDGE.—Higher grade school for the Monkland School Board, Coatbridge.

COLCHESTER.—Extension of Essex and Colchester Hospital (£2,000).

CONGLETON (West Heath).—Sanatorium (£9,000). Alf. Price & Son, architects, Sandbach, Cheshire; Birchall Bros., builders, Middlewich.

COVENTRY.—Block of workmen's dwellings for the T.C. (£13,630).

Factory. Selig, Sonnenthal & Co., owners.

CROSBY (Lincs.).—Council school (£5,967). H. J. Thompson, builder, Scunthorpe, Lincs.

CROYDON.—Extension of the Corporation Mental Hospital (£30,600).

DERBY.—Electric power station (£968). J. Tomlinson, builder, Derby.

DEVONPORT (Keyham Dockyard).—Two extensive workshops, stores and offices. Matcham & Co., Ltd., builders, 6, Addison Road, Plymouth.

DONCASTER (Balby-with-Hexthorpe).—New Council schools. F. W. Masters, architect, St. Vincent, Doncaster.

DOVER (Temple Ewell).—Villa residences. A. Tapley, builder, 6, Elms Road, Dover.

DROYLSDEN (Near Manchester).—Extensions at Robertson's Jam Works, Droylsden.

DUNDEE.—Reconstruction of works for James Prain & Sons, manufacturers, Walton Street.

Spinning shed for J. & A. D. Grimond, Ltd., Dens Road.

DURHAM.—New residential training college for women students for the C.C.

FARNWORTH (Bolton).—Proposed secondary school. H. Littler, County architect, Preston.

FOREST GATE.—Enlargement of Field Road United Methodist Church (£1,135). G. Barnes & Son, architects, 5, Clement's Inn, W.C.; Battley, Sons & Holness, builders, 21, Old Kent Road, S.E.

GAINSBOROUGH.—Reconstruction of market buildings for the T.C.

GARSTANG (Calder Vale).—Works for the Hollingreave Manufacturing Co., Ltd. Chas. Riley, architect, 16, Bank Chambers, Burnley.

GLASGOW.—Warehouse and office in Boden Street. W. Hollins & Co., Ltd., Boden Street, Glasgow, owners.

GLOUCESTER.—Wesleyan Hall to seat 750, and Sunday Schools to accommodate 500. J. Fletcher Trew, architect, County Chambers, Station Road, Gloucester.

GOLBORNE (Newton-le-Willows).—Intended new Council school for the Lancashire Education Authority.

HALIFAX.—Block of buildings in King Edward Street. W. C. Williams, architect; W. Midgley, solicitor, owner.

New houses in St. Alban's Road, Salterhebble. J. Howarth Shaw, contractor and owner.

New Houses at Willow Drive. H. Dilworth, contractor and owner.

HARPENDEN.—New Church (St. John's, £3,300). Phillips & Blake, builders, High Street, Harpenden.

HARWICH.—New Town Hall for the T.C. (£6,000).

HASLEMERE (Surrey).—House. Fredk. J. Hodgson, and Wm. Symonds, 8, Testard Road, Guildford.

HOLLINGWORTH.—Elementary school for 600 children. C. T. Adshead, Leinster Chambers, St. Ann's Square, Manchester, architect.

HORWICH (Lancs.).—Proposed new offices for Horwich and Westhoughton Educational Committee.

HULL.—Teachers' Training College in Cottingham Road (£9,000) for the T.C.

ILFORD.—Extension of St. Mary's Church (£2,500 to £3,000). C. H. and N. A Rew, architects, Great Berkhamsted.

LIVERPOOL (Sefton Park).—Large corner Pharmacy Stores and shop in Karslake Road. Arthur Begg (owner), 227, Kensington, Liverpool, E.

LLANELLY.—Station buildings for the Great Western Railway Co. S. Roberts, builder, West Hoe, Plymouth.

LONDON (Sydenham).—Addition to St. Mary's Oratory. Johnson, Saul and Co., 36, Thurloe Place, S. Kensington, W., builders.

(Blackheath).—Additions to High School for Girls. J. O. Smith, 46, Parliament Street, S.W., solicitor.

(Norwood).—Four shops. F. Carter, 34, Walbrook, surveyor.

(N.W.).—Flats at corner of St. John's Wood Road and Maida Vale for E. C. Pilkington.

(Vauxhall).—Quarters for single firemen (£2,500). Electric light to be installed. W. E. Riley, superintending architect L.C.C.

(Southwark Bridge Road).—Reconstruction of engine-room block for fire brigade (£4,908). W. E. Riley, superintending architect L.C.C.

(W.)—Additions to 15, Gloucester Square (£2,300). Joseph and Smithem, 83, Queen Street, Cheapside, E.C., architects.

(Denmark Hill, S.E.)—King's College Hospital (£300,000). W. A Pite, 116, Jermyn Street, S.W., architect.

(Bethnal Green).—Baptist Church at Winchmore Hill (£6,000). Rev. John Bradford, chairman of Building Committee.

(Hampstead Road).—Working class dwellings (£5,000). Joseph and Smithem, 83, Queen Street, Cheapside, E.C., architects.

(Aldgate).—Shops and offices (£3,000). Joseph and Smithem, 83, Queen Street, Cheapside, architects.

(Waterloo Road, S.E.)—Fire station. W. E. Riley, superintending architect L.C.C.

(Oxford Street).—Restaurant on site of No. 17. H. & E. Lea, 3 and 4, Warwick Street, Regent Street, W., builders.

(City).—Shop in Goswell Road. W. Irwin, 303, Essex Road, N., builder.

(W.C.)—Extensive buildings at corner of Torrington Place and Gower Street. Holland & Hannen, Hyde Street, Bloomsbury, builders.

(Euston Road).—Buildings on sites of 2-8, Mableton Place. H. L. Holloway, Church Street, Deptford, S.E., builder.

(Oxford Street).—New concert hall for Mr. Ascherberg, owner.

(Norwood Road, S.E.).—Four shops. F. Carter, 34, Walbrook, E.C., surveyor.

(E.C.).—Shops, offices, &c., on sites of 13-21, West Smithfield, and 22-26, Hosier Lane. Geo. Vickery, 50, Gresham Street, E.C., architect; Killby & Gayford, 87, Worship Street, Finsbury, builders.

MANCHESTER.—New school for 1,000 children in Thornwood Avenue, Gorton, for the Gorton Education Committee.

Proposed new hotel for Great Central Railway Co.

(Cheetham).—Infant school and additions to Southall Street School for the Education Committee.

MANSFIELD WOODHOUSE (Notts).—Council schools (£5,528). W. Crane, Ltd., builders, 80, Forest Road, W., Nottingham.

MORETON-IN-MARSH.—Extension of Council schools (£978). R. Turner, builder, Adlestrop, Chipping Norton.

NANTWICH (Cheshire).—New Cottage Hospital (£2,000).

NEATH (Glyn Neath).—30 houses for the Maesymarchog Building Club. J. Cook Rees, architect, St. Thomas Chambers, Neath.

NORTHALLERTON.—New Police buildings and residences for the deputy chief constable and chief clerk for the North Riding of Yorks C.C. (£14,000).

NOTTINGHAM (East Kirkby).—New Primitive Methodist Sunday Schools. P. Cupitt, Forest Street, East Kirkby.

NOTTINGHAM.—New baths for the T.C.

OLDHAM.—New ring spinning mill, projected to run 60,000 ring spindles, Royton. Royton Ring Spinning Co.

PONTYPOOL.—New Free Library for the U.D.C. Speir & Beavan, architects, Borough Chambers, Wharton Street, Cardiff.

(Blaenavon).—Motor house and laundry at Park House. Teather and Wilson, architects, Andrews' Buildings, Queen Street, Cardiff.

PONTYPRIDD (Miskin, Penrhiwceiber).—Shops, bakehouses, stables and manager's residence for the Cwmbach Co-operative Society. T. Roderick, architect, Ashbrook House, Clifton Street, Aberdare.

RADCLIFFE (Lancs.).—Proposed Secondary School at Stand for Radcliffe, Prestwich and Whitefield. H. Littler, county architect, Preston.

REDCAR.—New County Council school (£10,000).

REDHILL (Surrey).—New elementary schools. T. R. and B. Hooper, architects, Market Hall, Redhill.

REIGATE (Earlswood).—New elementary school for the T.C.

RHYMNEY (Mon.).—Extensive additions to Rhymney Brewery for A. Buchán and Co. T. Roderick, architect, Ashbrook House, Clifton Street, Aberdare.

ST. ALBANS.—High school for girls. A. L. Champneys, architect, 99, St. Peter's Street, St. Albans.

ST. HELENS.—New public schools. F. S. Biram, architect, Hardshaw Street, St. Helens.

New schools for the T.C. F. S. Biram, architect, Hardshaw Street, St. Helens.

SHEFFIELD.—New general post office. H.M. Office of Works.

SKEGNESS.—New public school (£3,500).

SOUTHPORT.—Council school, Lenaker and Sefton Street (£20,000). J. E. Jarratt, clerk, Education Authority, Southport.

STAFFORD.—Isolation hospital for the T.C.

STOCKPORT.—The Stockport Sunday School is to be enlarged at a cost of £12,000.

New public sewerage works to cost £25,000.

Proposed New Council School in Edgeley Park, Stockport.

STROUD (Chalford Hill).—Extension of public schools (£1,241). A. S. Cooke, builder, Stroud (Glos.).

SUNDERLAND (New Seaham).—Workmen's Club and Institute (£4,000). O. H. Mark, architect, Sunderland; John Huntley, builder, Sunderland.

Reconstruction of the Avenue Theatre. Mr. Thornton, owner.

Cottage Homes for the B. of G. (£12,850). W. & T. R. Milburn, Sunderland, architects.

SWINDON.—Important extensions at the Great Western Hotel. W. Drew, architect, Swindon.

TENDOYLAN, COWBRIDGE (Glam.).—Residence for Mr. B. Parsons. W. Morgan, architect, 11, Bute Crescent, Cowbridge Road, Pontyclun (Glam.).

TOTTENHAM.—Five houses. Hodson & Whitehead, 7, Finsbury Square, E.C., architects.

Additions to Paxton Hall. H. Grover & Co., Ltd., 752, High Road, Tottenham, builders.

Boiler house, stores and workshops for Metropolitan Asylums Board (£4,996). W. Hatch, engineer to the Board, Embankment, E.C.; E. Wall, Summerstown, S.W., builder.

TRAWDEN (near Burnley).—New Council school (£9,000). H. Littler, County architect, Preston.

TUNBRIDGE WELLS (Southborough).—Crown Inn to be rebuilt. E. and H. Kelsey, Culverden Brewery, Tunbridge Wells, owners.

WESTGATE-ON-SEA (Thanet).—New public hall (£5,500). Chas. John Reeve, architect, The Grosvenor, Margate.

WEST HAM.—Extension of West Ham and East London Hospital (£20,000). H. Percy Adams, architect, 28, Woburn Place, London.

WHITEHAVEN.—Place of worship, New Lowther Street (£1,300). J. Young, builder, Whitehaven.

WINCHESTER.—Head master's house, Peter Symond's School (£3,827). Cancellor & Hill, architects, 12, Jewry Street, Winchester.

WOLVERHAMPTON.—Important extension of works. John Marston, Ltd., owners.

New public schools for 488 children for the T.C.

WORKSOP.—St. John's Institute and parish hall. J. T. Shardlow, architect. Rev. G. Dobree, vicar.

Thirty houses. C. Bacon, Worksop, owner.

Extensive brickworks at Checker House between Worksop and Retford for the Wigan Coal and Iron Co., of Manton, Worksop, Notts.

WREXHAM.—Elementary school for 1,000 children for the Education Committee.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 8th, 1908. One common battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria, Street, S.W.

Austria.—August 31st. The Austrian State Railway authorities at Czernowitz are inviting tenders for the establishment of an electric plant at the railway station in that town, for lighting and power purposes.

Barnes.—August 12th. Mechanical stokers, feeder and distributor cables for the U.D.C. See "Official Notices" July 26th.

Belgium.—August 14th. La Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels, is inviting tenders for the machinery and apparatus necessary for the equipment of three transformer sub-stations in connection with electric tramways.

Bristol.—Converters, switchgear and cables for the T.C. See "Official Notices" to-day.

Calcutta.—January 2nd, 1908. According to the *Financial News*, tenders for any class of illuminant are invited by the Corporation for the lighting of the city.

Canada.—According to the *Electrical World*, the Board of Control, Winnipeg, Manitoba, desires tenders for five 3,000-kw. turbines and alternators, two 250-kw. ditto, transformers, power station switchgear, a high-pressure transmission line, 75 miles in length, and all the accessories, making up a complete installation. Specifications from the power engineer, Carnegie Library Buildings, Winnipeg.

Clonmel.—September 7th. Electric lighting of the District Lunatic Asylum. Section 1, suction gas plant, engines and dynamos. Section 2, accumulators, switchgear, mains, wiring and fittings. Section 3, buildings and foundations. See "Official Notices" to-day.

Dortmund.—August 15th. The Prussian Railways require tenders for a 20-ton electric crane and accessories.

Dublin.—Supply of motors on hire-purchase system for the Corporation E.L. Committee. See "Official Notices" July 26th

Dundee.—Tenders are invited by the T.C. for the construction of a mile of double-track tramway, rails, points, crossings, &c. Particulars from City Engineer.

Egypt.—November 1st. The Harbour authorities require tenders for the construction of an electric power station and for the following plant, to be worked by electric power:—Five transporters of large range; five ditto of smaller range; six cranes of 4 tons each; 36 cranes of 2 tons each; 25 capstans; cables, feeders, &c. Particulars may be obtained from the Directeur des Posts and Phares.

Germany.—Tenders are about to be invited for the extension of the municipal electric lighting undertaking in the town of Dortmund at an estimated cost of £233,300.

Gothenburg.—The Commercial Intelligence Branch of the Board of Trade are notified by H.M. Consul at Gothenburg that tenders are invited for the supply of the electric equipment for the Government power station at Trollhattan. For further particulars see this column for July 26th.

Islington.—The Libraries Committee of the B.C. has been authorised to obtain and accept during the vacation, tenders for the electric fittings for the Central Library.

Italy.—August 24th. The municipal authorities of Campanario are inviting tenders for the concession for the electric lighting of the town during a period of 20 years.

Llandudno.—September 2nd. Supply and erection of battery, booster, &c., for the pier company. See "Official Notices" to-day.

Mansfield.—Maintenance of electric installation at the Town Hall for the T.C. J. Harrop White, Town Clerk, Mansfield.

New Zealand.—The T.C. of Napier requires tenders for a complete electric lighting, tramway and power installation.

Oystermouth.—The U.D.C. is inviting applications from those willing to establish an electrical undertaking there. See "Official Notices" to-day.

Paddington.—August 12th. Electrical installation of fire alarms at the workhouse in Harrow Road, for the Guardians. Specification, &c., from H. F. Aveling, Clerk to the Guardians, 313-319, Harrow Road, W.

Portsmouth.—August 14th. High-tension switchboard, and pipe-work for electricity supply extensions. See "Official Notices" July 26th.

Queensland.—September 9th. The Deputy Postmaster-General requires tenders for the supply of lead-covered paper-insulated telephone cable, also various post and telegraph stores, telegraph and telephone instruments, parts, &c. Specifications of the above, and of a number of other tenders for telegraph and telephone material, may be inspected at the office of the Electrical Review.

South Australia.—The Postmaster-General requires tenders for lead-covered paper-insulated telephone cable with 12½ conductors, as follows:—7½ miles 208-pair; 3½ miles 156-pair; 4 miles 104-pair; 2½ miles 78-pair; 7 miles 52-pair; 2½ miles 26-pair; and 700 yards light lead-covered silk and cotton-insulated cable.

Spain.—August 19th. The municipal authorities of Serrada (province of Valladolid) are inviting tenders for the concession for the electric lighting of the town during a period of ten years. Tenders are to be sent to El Secretario del Ayuntamiento de Serrada, whence particulars may be obtained.

Spain.—August 12th. The Spanish Ministry of Public Works in Madrid is inviting tenders until August 12th for the concession for the construction and working of an electric tramway in the town of Valencia.

Spain.—August 18th. Tenders are invited for the lighting by electricity, or by electricity and gas, of the city of Alcoy. Tenders to the "Secretaría de la Alcaldía constitucional," of Alcoy. Local representation is necessary. A deposit of 600 pesetas (about £21) is required to qualify any tender.

Stockport.—August 26th. Automatic point controllers for the T.C. See "Official Notices" August 2nd.

Sunderland.—August 22nd. Uniforms and caps for the tramway employés of the Corporation. See "Official Notices" July 19th.

Sydney (N.S.W.).—August 14th. The Deputy Postmaster-General is inviting tenders for telegraph, telephone and electric light material.

CLOSED.

Blackburn.—The Corporation has accepted the tender of Messrs. Dick, Kerr & Co., and Messrs. Newtons, Ltd., for the supply of electric motors, and that of Messrs. Ferranti, Ltd., for the supply of electric meters.

Cape Town.—The T.C. has accepted the tender of the British General Electric Co. for 1 and 2 H.P. motors, and that of Green & Trevett (on behalf of the British Westinghouse Co.) for motors of 3 H.P. and over. For the supply of starting switches, the tender of Messrs. G. Findlay & Co. has been accepted.

Cleckheaton.—The U.D.C. has accepted the tender of W. T. Henley's Telegraph Works Co., Ltd., for the supply of cables for a year.

Ealing.—The T.C. has accepted the tender of Messrs. G. Sinclair & Son for the supply of a boiler for the electricity works, at £3,069.

France.—The Post and Telegraph Authorities in Paris have just given out contracts for the supply of galvanised iron wire as follows: 10 tons 1 mm. dia. and 150 tons 3 mm. dia. La Société des Forges et Acieries de Commercy (Meuse); 100 tons 4 mm. dia. La Société des Forges de Chatillon Commentoz, and 100 tons 4 mm. dia. M. Marcellot of Eurville (Haute-Marne).

Halifax.—The tenders of Messrs. Dobb Bros. for Haigh Moor pea slack coal, and of Messrs. Henley's Telegraph Works Co., Ltd., London, for cable, have been accepted.

Hull.—The E.L. Committee on August 2nd accepted the tender of Messrs. Korting Bros. for the supply of pipework and a condenser, at £625; also the tender of the Lahmeyer Electrical Co., Ltd, for the supply of a steam dynamo, at £4,564.

London.—Metropolitan Asylums Board.—The Board has accepted the tender, at £815, of Mr. A. L. Underwood for the sale to him of the electrical generating plant at the Tooting Bec Asylum. The Board's engineer (Mr. W. T. Hatch) estimated the plant would fetch between £1,000 and £1,500.

Stepney.—The B.C. has received the following tenders:—

Testing Equipment.

A. W. Penrose & Co.	£357	10	0
" (modified tender) (accepted)	362	10	0
Union Electric Co.	393	3	0
Johnson & Phillips	415	0	0
W. White & Co.	433	3	6
Switchgear Co. (J. G. Statter & Co.)	427	2	6
Electric Construction Co.	446	0	0
Edison & Swan U.E.L. Co.	455	0	0
Pooley & Austin	468	0	0
Kelvin & J. White, Ltd.	538	16	5
British Thomson-Houston Co.	542	0	0
General Electric Co.	675	0	0

The modification was in respect of the motor-generator. In their tender Messrs. Penrose offered to supply same for £107 10s., but agreed by their letter dated July 24th to supply a generator of a better type and greater efficiency.

Annual Supply of Meter Cases.

W. Badger (accepted)	£99	5	0
J. & W. Shale	118	17	6
J. Richmond & Co.	121	17	6
Buck & Hickman	123	5	0

Annual Supply of Time Switches.

Reason Manufacturing Co. (accepted)	£188	0	0
Venner & Co.	294	10	0
Johnson & Phillips, Ltd.	371	0	0

Manchester.—Tenders have been accepted by the Tramways Committee as follows:—

Lorain Steel Co., Philadelphia.—Special track-work.
Bolckow, Vaughan & Co., Middlesbrough.—Steel girder tramway rails and fish-plates.
Bayliss, Jones & Bayliss, Ltd., Wolverhampton.—Steel tie-bars and bolts and nuts for fish-plates.
John Spencer & Co., Wednesbury.—Steel tramway poles.
Naylor Bros., Golborne.—Span wire brackets.
United States Steel Products Export Co., New York.—Tramway rail bonds.

The Cleansing Committee has accepted the following tender:—

Century Electric Co.—Work in connection with the electric installation at the Caythorpe Street destructor works, Moss Side; the work to be done under the supervision of the chief electrical engineer of the Corporation

The Electricity Committee has accepted the following tenders:—

British Insulated & Helsby Cables, Ltd.—Fuse boxes.
Rumney & Rumney, and Ferranti, Ltd.—Ampere-hour meters.
International Electric Co., Siemens Bros. Dynamo Works Co., and the General Electric Co.—Watt-hour meters.

Swansea.—The tender of Mr. J. S. Brown has been accepted for the E.L. installation at the Swansea National Eisteddfod pavilion, at £127.

Wolverhampton.—The T.C. has accepted the tender of Messrs. Mountain & Gibson, Ltd., Bury (Lancs.), for the supply of a snow-plough machine for the tramways, at £702 10s.

FORTHCOMING EVENTS.

Saturday, August 10th.—At 3 p.m. Visit of the Association of Engineers-in-Charge to the General Post Office Central Telephone Exchange, Carter Lane, E.C., by permission of the Engineer-in-Chief to the the G.P.O. (Plant being installed by Western Electric Co.)

A German Railway Investigation in the United States.—A Committee of Inquiry into the question of electric railway working in the United States is on the point of departure from Berlin to New York, in connection with the long discussed scheme for the introduction of electric traction on German railways, and particularly on the Berlin city railways. At the head of the Committee is Architect Wittfeld, of the Prussian Ministry of Public Works, and the other members are Dr. W. Reichel, professor at the Technical High School; Herr P. Wittig, director of the Berlin Elevated and Underground Railway Co.; Herr Frischmuth, chief engineer of the Siemens & Halske Co.; Herr Pforr, of the Allgemeine Electricity Co.; and Herr Lahmeyer. Dr. Reichel will probably be remembered as the former chief engineer of the Siemens & Halske Co., and the manager of the high-speed electric railway trials which took place in the autumn of 1903, on the section of the military railway between Marienfeld and Zossen, and which resulted in the attainment of speeds up to 130 miles an hour. Among other lines the Committee intends to inspect the Baltimore-Washington-Annapolis Railway, which is equipped on the Westinghouse single-phase system, together with the elevated and tunnel railways in the United States. It is stated that the Berlin State Railway Administration will soon prepare plans for the conversion of certain lines as a result of a recent order made by the Minister for Railways, although nothing of practical value can really be accomplished until the return of the Committee, and the presentation of its conclusions.

Measurement of Stock Cable.—We wish to point out to cable manufacturers and electricity supply undertakings that the former would confer a considerable convenience upon the latter by having all cable bought for stock distinctly marked with the measurements from the commencement on the drum at intervals of, say, one or two yards, so that all quantities cut off for laying mains and services could be easily checked, and what is of more importance, the balance in hand could be easily ascertained without the cost of labour to unwind and measure stock in hand at balancing periods. It frequently happens, with cable of any considerable dimensions, that the book balance is accepted at stocktaking, and unless great care is exercised in recording issued lengths from time to time, a surplus or deficit is the result when the drum is finally emptied. In the case of large sized lead-covered cable, the measurement could be stamped on without injury to the protection, whilst with small lead-covered and braided cables, a metallic disk could be firmly clipped in position. The cost to the manufacturer would be negligible, whilst the benefit accruing to the customer would be considerable.

THE ELECTRIFICATION OF THE HAMMERSMITH AND CITY SECTION OF THE GREAT WESTERN RAILWAY.

(*Continued from page* 165.)

In our last week's issue we referred at some length to the extensive coal-handling plant, also to the boiler house plant installed at the Park Royal station.

In this connection figs. 4, 5 and 7, showing the exterior of the station, the boiler house, and two of the Hall feed pumps, will be of interest.

As previously stated, the feed pumps normally draw from the hot wells, two of which are situated in the boiler house basement.

For dealing with the supply to the hot wells, both water softening and oil separating and filtering plants are installed in the pump room.

The former, which is of the well-known Paterson type, and arranged in duplicate on either side of the pump room, will as a whole treat some 5,000 gals. of hot well make-up per hour. The latter plant, also in duplicate, is of the Davis-Perrett type, and will deal with 8,000 gals. of water per hour.

One section of this plant is illustrated in fig. 6; its action is as follows:—

The air pump discharge is delivered into a small settling

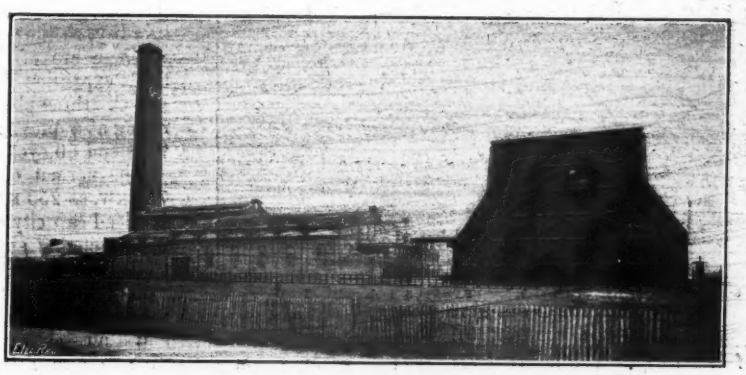


Fig. 4.—Exterior of the Park Royal Generating Station of the Great Western Railway Co.

Fig. 5.—View in the Boiler House, showing the Babcock & Wilcox Double-drum Water-tube Boilers.

tank with a tumbling bay outlet and with float and measuring gear, in which some of the free oil is separated by gravitation. The tumbling bay discharges into a distributing trough, from which the oil separating batteries are supplied through a number of valves, arranged so that any unit of the battery may be entirely shut off if required, without interfering with the efficient working of the plant. The batteries consist of long wooden troughs, in which are suspended iron plates alternately connected to either pole of the 225-volt D.C. supply, and controlled by a change-over switch, so that the polarity can be reversed as required in order to keep the plates clear of the grease which accumulates as a scum on the surface of the water. The discharging water is led to a sand filter, which is also divided into sections; the filtered water passes into the hot well tank below. When the water rises to a certain level above the sand filter, owing to the latter becoming clogged, the filter is automatically cleaned by flushing it with water, which passes through the sand in the opposite direction to the normal.

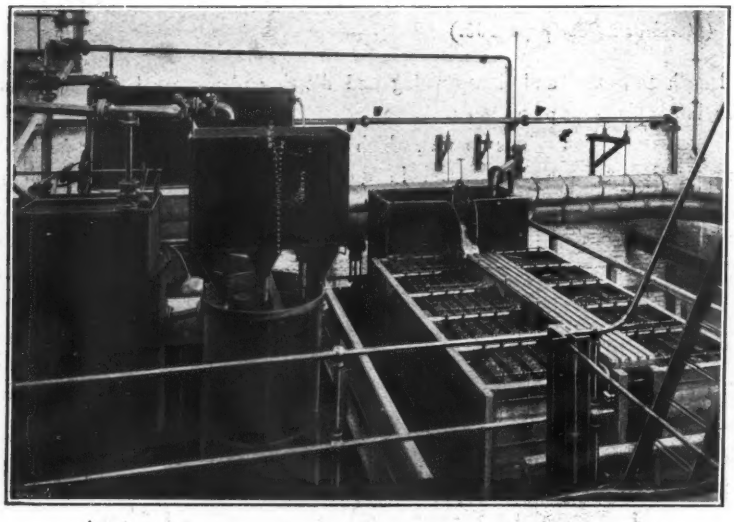


FIG. 6.—DAVIS-PERRETT OIL SEPARATING APPARATUS FOR TREATING THE AIR PUMP DISCHARGE.

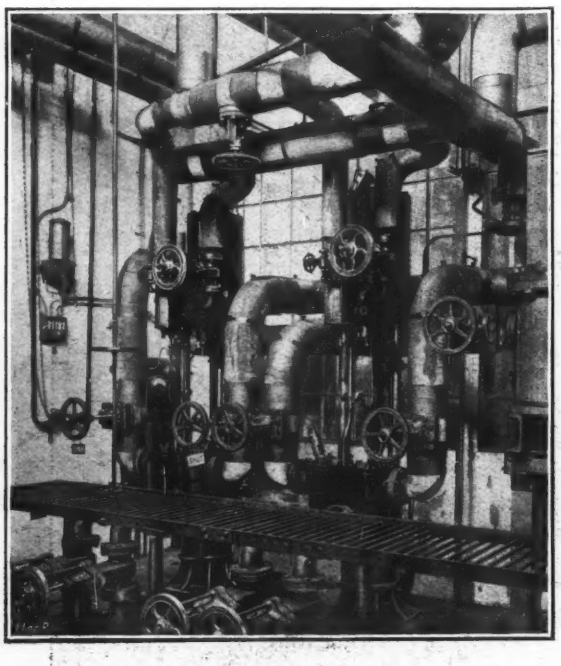


FIG. 7.—THE HALL FEED PUMPS.

The whole of the steam piping is of solid-drawn steel tube with steel flanges riveted on, and was supplied by Messrs. Aiton & Co.

Each boiler is connected, through a non-return valve and stop valve, to two 8-in. main steam pipes carried down the sides of the boiler house and inter-connected above the pump room. A 10-in. ring in the engine room is teed off the double line in the boiler house through the necessary valves, and is itself sectioned by valves; the main engines are arranged in pairs, each engine being supplied with steam through an 8-in. branch pipe connected to the separator on the engine bedplate, and a bye-pass pipe and valve is provided between the separators on each pair of engines, for use in case a section of the main ring has to be shut off.

Eight main generating units are installed in the engine room, four in each side bay, as shown in figs. 12 and 13.

These are of the Belliss three-crank triple-expansion type, direct coupled to E.C.C. three-phase alternators, generating at a pressure of 6,300 to 6,600 volts and 50 cycles.

The normal output of these units is 750 KW. at 250 R.P.M., and they have an overload capacity of 25 per cent.

The engine speed is electrically controlled from the main switchboard gallery for synchronising purposes and for load adjustment when running; and an electrically-controlled emergency steam stop-valve is also fitted to each engine and similarly controlled from the switchboard.

The three-phase generators are of the ordinary rotating field type; the armature is star connected, but the centre point is not permanently earthed.

The exhaust steam from each engine passes through a preliminary mechanical oil-separator of the Reavell type to the condensing plant; an alternative atmospheric exhaust is also provided to each engine.

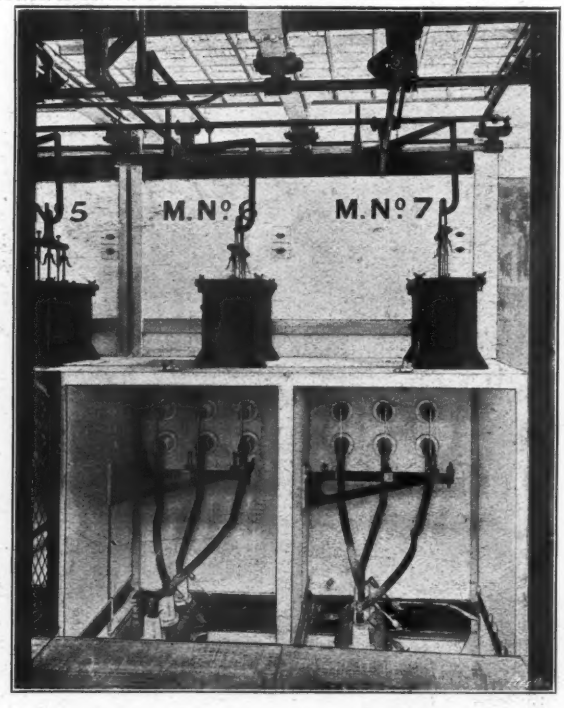


FIG. 8.—PHASE CHANGING LINKS, IN CONNECTION WITH THE MAIN E.H.T. SWITCHGEAR.

The condensing plant, shown in fig. 10, is situated in the centre bay of the engine room, and is divided into four sections, one for each pair of engines; each section consists of a surface condenser, combined air and force pump and

circulating pump. Each condenser unit deals with 42,000 lb. of exhaust steam per hour. The air pumps, of the Edwards type, are driven direct by a two-crank compound steam engine, and a small force pump is also driven by each air pump engine, for raising the condensed water to the oil separating and filtering plant in the pump house. The circulating pump is of the centrifugal type, designed to deal with 178,000 gals. of water per hour, and is driven by a three-phase 650-volt motor. The circulating pumps draw from four 20-in. pipes in the engine house basement, and return the circulating water through the condensers and non-return valves to two main discharge pipes, situated some 30 ft. above floor level, and shown in fig. 9, which lead through the end wall of the building to four Klein natural draught cooling towers. The latter are each designed to cool 145,000 gals. of water 35° F., from 115° F., under normal temperature conditions.

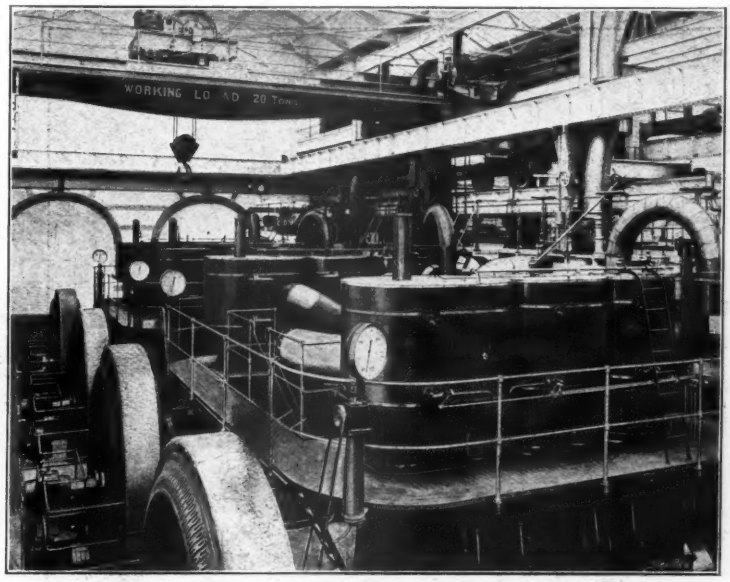


Fig. 9.—View of a Generating Bay from the Switch Gallery.

A measuring weir is provided in the main distributing trough above the towers, and the separate concrete storage tanks under each tower are connected with the circulating suctions of the condensing plant.

Eight auxiliary units, each of 150-kw. capacity, are also installed in the engine-house for supplying direct and alternating current for local purposes, principally excitation and lighting (d.c.), and operating motors (a.c.).

There are four d.c. auxiliary units, including a steam generator driven by a Belliss compound engine, a generator driven by a 6,600-volt three-phase induction motor, and two batteries. The batteries, which form a stand-by for the excitation supply, are worked in parallel with the generators in the usual way, with motor-driven boosters for charging them from the bus-bars.

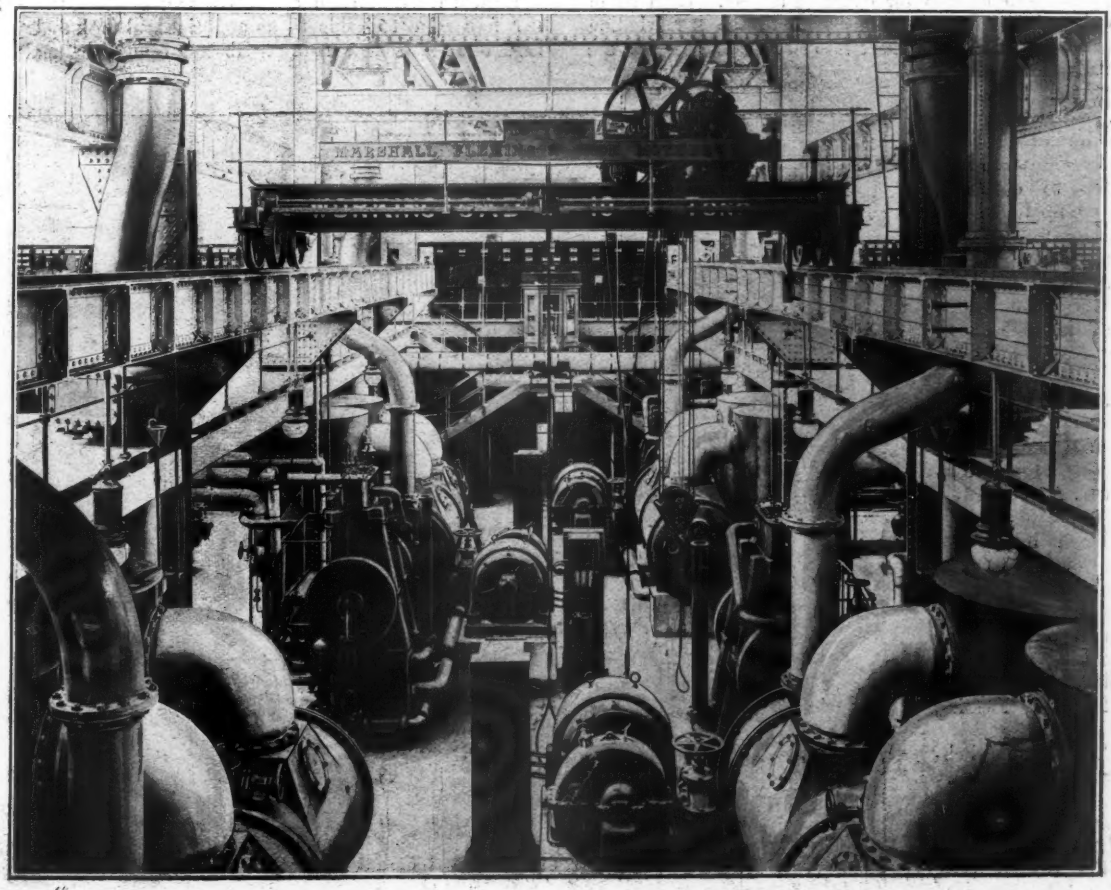


Fig. 10.—The Central Engine House Bay, showing the Surface Condensing Plant.

Four three-phase auxiliary units are also installed, including a steam generator driven by a Belliss compound engine, a synchronous generator driven by a 225-volt d.c. motor, and

two sets of static transformers. The motor-generator can be run reversed through the transformers or direct from the auxiliary three-phase supply, for delivering D.C. for excitation,

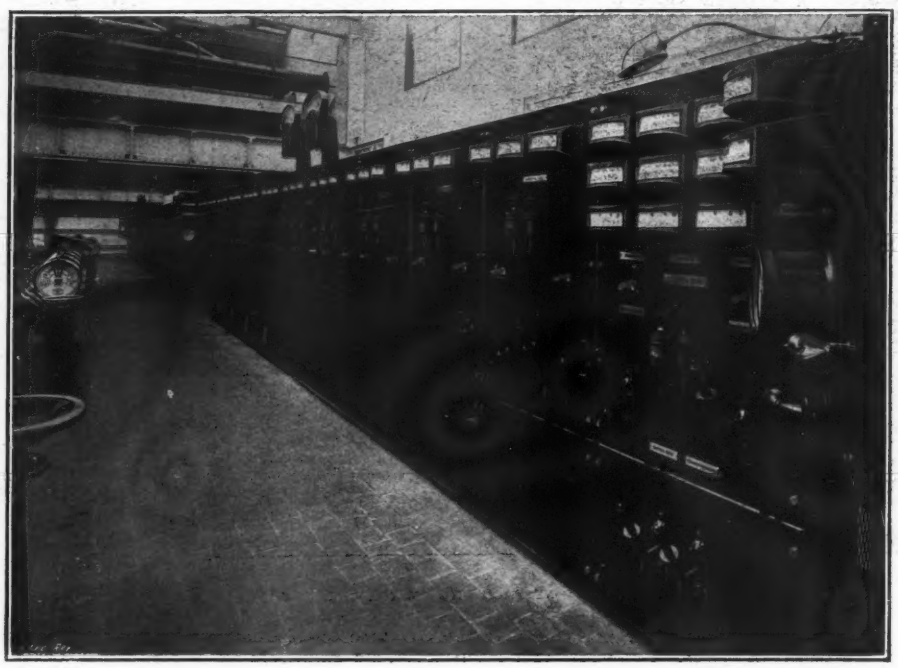


Fig. 11.—Main E.H.T. Switchgear; View along the Control Gallery.

and it can also be used for charging feeders. Each set of static transformers is delta connected, and the H.T. winding of each transformer is divided into two sections, which are normally connected up in parallel from the H.T. switchgear, but can be connected up in series when it is desired to obtain a pressure up to 13,000 volts for testing purposes.

A 20-ton overhead travelling crane is provided in each generator bay of the engine house; each crane is of the three-motor type, with 220-volt D.C. motors, and tramway type controllers. A 10-ton crane is also provided in the condenser bay, fitted with motor operated hoisting, and hand travelling gear. The cranes, both at the generating and substation, were supplied by Marshall, Fleming and Jack.

The main switchgear is of a very extensive character, as would be expected from the nature of its work. It is of B.T.-H. type, and includes two H.T. switchboards for controlling the 6,500-volt three-phase circuits, with an auxiliary 650-volt three-phase switchboard between, placed on a gallery across one end of the three engine-house bays; also two auxiliary 220-volt D.C. switchboards placed on the floor level immediately under the H.T. switchboards.

The high-tension switchgear extends from the basement to a total height of 33 ft., and consists of a steel framework filled in with stone fireproof cells. Each circuit runs from the bottom to the top of the board. The control panels are placed on a gallery in front of the upper portion of the switchgear. The main switches are mechanically worked from the control panels; the instruments on the control panels are worked from transformers, low-pressure current only being employed on the operating boards. Immediately in front of the control panels, fig. 11, are placed the main generator field regulating resistance columns, the engine governor and emergency valve switches, and also a set of engine signal columns and indicators.

Each H.T. switchboard controls four generators, three ·15 H.T. feeders, a ·15 cable to an artificial load tank and some local circuits leading to a distributing centre, the auxiliary

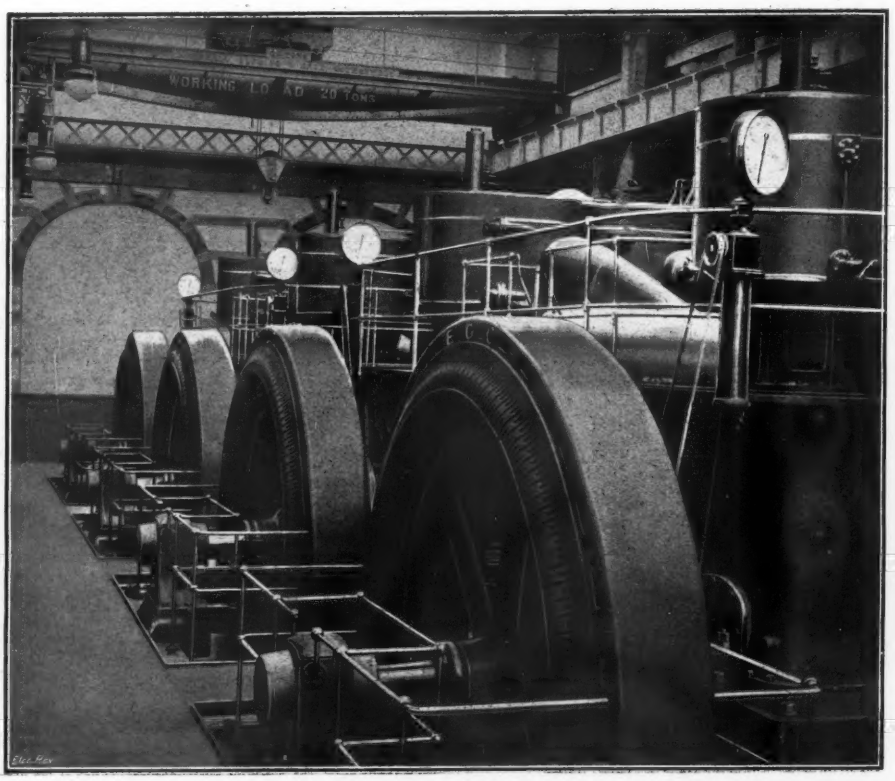


Fig. 12.—The 750-kw. Three-phase E.C.C. Generators.

transformers, and, in the case of the north board, the induction motor-generator. The H.T. switchboards can be worked independently of each other or in parallel. Each

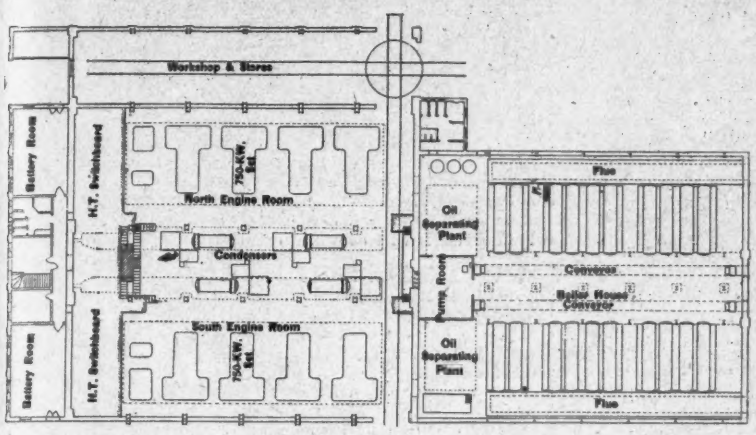


FIG. 13.—SHOWING THE ARRANGEMENT OF THE PARK ROYAL GENERATING STATION.

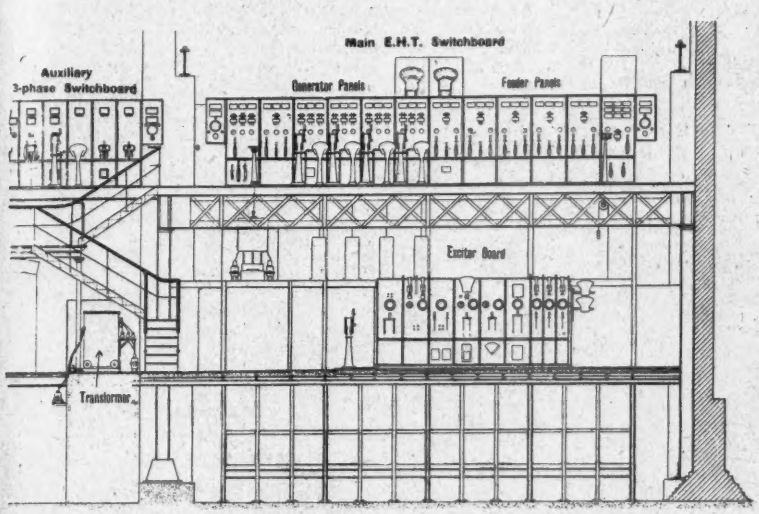


FIG. 14.—HALF ELEVATION OF THE MAIN SWITCHBOARD.

board has a duplicate set of main bus-bars, and also a set of H.T. synchronising bus-bars which are used in connection with the testing and charging of the feeders, as well as for synchronising the generators.

The circuit for a generator or feeder starts in the basement in a cell which contains the three-core cable sealing and dividing box, to which it is connected by phase-changing links (fig. 8) for enabling any core of the cable to be connected to any one of the conductors of the switchboard circuit. Above the phase-changing links, a set of disconnecting links enable the cores to be isolated from the switchgear and earthed, glow tubes being provided to indicate when the cable is alive. The circuit then passes upwards to three oil-break automatic switches, the lowest of which is directly connected to the synchronising bus-bars, while the two upper switches connect to one or other of the two sets of main bus-bars. The main bus-bar switches are used as selector switches, and also serve as a stand-by to each other. The generators or feeders can be changed from one set of bus-bars to the other through the generator's own switches, or through a separate bar coupling switch. The necessary pressure transformers and series transformers for working the instruments are teed off or connected in the circuit on the cable side of the main switches, and these same transformers energise the relays in connection with the main switches.

Each main generator panel is provided with a watt-hour meter, an indicating wattmeter, a power factor indicator and an ammeter; and each feeder with three ammeters.

With regard to the automatic protection of the H.T. circuits, the main switches on each of the main generator circuits are provided with instantaneous reverse and with time limit overload relays, which, however, can be neutralised when desired. Time limit overload relays are also provided on the main feeder circuits, the cables cross-connecting the two main boards, the bus-bar coupling circuits, the branch circuits and the feeder H.T. synchronising selector switches which also connect the H.T. water box.

The tripping solenoids are energised by direct current from the battery, and the tripping of a main switch is

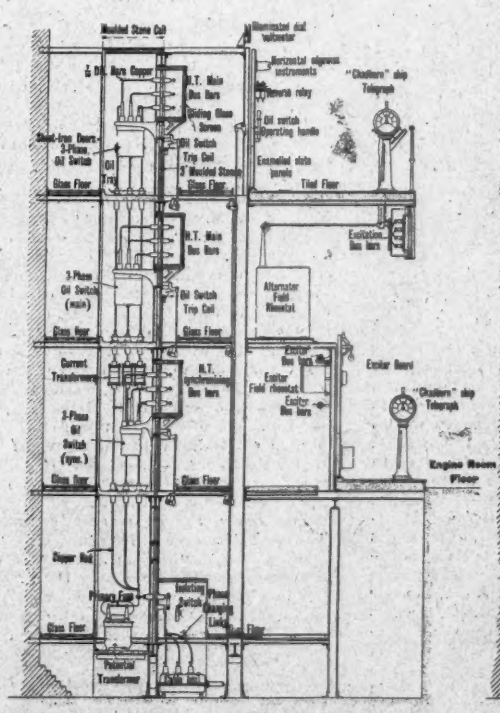


FIG. 15.—SECTION THROUGH GENERATOR CELLS.

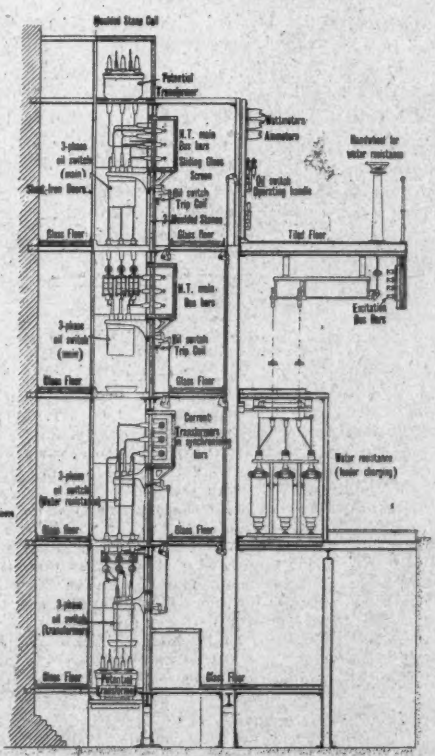


FIG. 16.—SECTION THROUGH CHARGE AND TEST CELLS.

notified by the lighting up of a signal lamp on the control panel.

A charge and test panel is provided on each main H.T. switchboard for the purpose of testing and charging the main H.T. feeders, either by means of a water box consisting of three-phase series variable water resistances or from the auxiliary 650-volt switchboard through the step-up transformers. Ammeters and earth-detecting voltmeters are provided, the latter for indicating a fault on the feeder being charged or on the network being supplied.

One half of the synchronising bus-bars is normally used for synchronising the generator circuits, and the other half for charging and testing the feeders, but the halves can be coupled together, and the feeder charging gear connected to any generator, or the generator synchronising gear used in connection with the feeders. Each control switchboard is provided with generator and feeder synchronising gear mounted on swing panels at either end of the board.

By means of a system of shafting and cams at the back of each control board, a complete mechanical interlock has been provided in connection with the operating mechanism of the H.T. switches.

The auxiliary three-phase switchboard, for controlling the 650-volt alternating current circuits, is fitted with two sets of bus-bars which can be coupled together when required; the arrangement of the auxiliary switchgear is such that either the steam or motor-driven 650-volt alternator can supply from the lower set of bus-bars for charging or testing purposes, while the other alternator or other bank of transformers (stepping down) supplies from the top set of bus-bars the auxiliary motors.

The two D.C. 220-volt exciter switchboards can be worked separately or in parallel, and each controls one of the auxiliary D.C. generators, one of the storage batteries, three feeders for working the D.C. crane motors and the arc and incandescent lighting of the power house, and an excitation circuit for the main and auxiliary three-phase generators.

Two testing tanks, supplied with circulating water, are provided, each of which forms an artificial load of the capacity corresponding to a main generator. The electrodes for these tanks can be raised or lowered by hand, or by means of small motors which can be controlled from the main switchboard galleries.

A portable electrically-driven air-compressor set is provided for cleaning the H.T. windings and switchgear about the engine room.

For the lighting of the buildings, &c., 40 "Oriflame" arc lamps, and about 200 incandescent lamps are provided.

The feeder cables from the 650-volt A.C. auxiliary switchboard and from the D.C. switchboards are three-core and single cables respectively, rubber insulated, lead-covered, and armoured with steel wire. For the branch circuits rubber-insulated and braided cable is used, drawn into heavy gauge Simplex steel conduit. With the exception of the offices, water-tight fittings have been used throughout.

(To be continued.)

NOTES.

Zircon-Wolfram Lamps.—A certain amount of interest will be manifested in the information contained in the first report of the Belgian Compagnie Internationale des Lampes Electriques Zircone-Wolfram, whose principal object is the promotion of the commercial utilisation of this type of lamp in various countries. It is mentioned that the company has concluded an agreement with a Belgian group, under which the latter will acquire the Belgian patents in connection with the factory now being erected in Brussels. The Russian and Swiss works, which have taken up the patents for those countries at Warsaw and Goldau respectively, are now producing lamps of good quality, whilst the Société Edison-Cruto, which obtained an option of the Italian patents, exercised it four months before expiration. It is submitted that this shows the superiority over other lamps of those patented by the Elektroden Gesellschaft and improved by Messrs. Hollefreund & Co., in their works at Berlin. When the Belgian company was formed, the first Z lamps of 110 volts had just made their appearance in the laboratory of the inventors, and to-day the 220-volt lamps are in general manufacture. Whilst the illuminating power of the first 110-volt lamps did not fall below 80 candles, those made at present range down to 20 candles, and the cost price has been so largely reduced as to indicate that it will approach that of the best carbon filament lamps. The firms of Bergmann & Co., of Berlin, the Felten and Guilleaume-Lahmeyer Works, the Watt Co., of Vienna, the Société Lacarrière, of Paris, and the Z Electric Lamp Syndicate, of London, have all adopted the same process as the Belgian Co., and have started, or are about to begin, manufacturing on a large scale. The report proceeds to state that Messrs. Hollefreund & Co., of Berlin, have discovered how to prevent the blackening of the lamp bulbs by the filaments, and that the Belgian company has secured the exclusive agency for the disposal of the patents for these and other improvements in other countries. A conference was held recently at Berlin of the principal manufacturers of metallic filament lamps with a view to arriving at an understanding for the maintenance of sale prices on a remunerative level, and thus avoiding competition by means of rebates. An arrangement of this kind was entered into for a certain period, and there is reason for believing that it will be continued.

A West Indian Shark Story.—According to a letter received by a German newspaper from a young sailor at St. Thomas, in the West Indies, the harbour there is troubled with the presence of a number of sharks which, except in shallow water near the shore, are a hindrance to bathing, which is deemed necessary during the hot weather. Two negroes were recently devoured by sharks, and the engineer of an American training ship anchored at St. Thomas hit upon the idea of killing the sharks by means of dynamite. Accordingly an iron fishing hook was baited with a 5-lb. piece of bacon in which was concealed a dynamite cartridge, which was connected with electrical conductors and an igniter. The bait was lowered into the water by a strong rope, and the other end of the wires connected to a battery. It was not long before a shark 12 ft. long made its appearance at the stern of the ship, when it turned on its back and the bait was swallowed. The shark killer switched on the current, and at the same moment the dismembered pieces of the animal flew into the air with a column of water. In ten days no fewer than eight large sharks were destroyed in this manner. Encouraged in this way the engineer endeavoured to kill the animals by electric shock. A thin cable, which was capable of being connected with a lighting circuit on board the vessel, was got ready with the hook at one end, and having the usual form of bait which was lowered into the sea. The other end of the cable, according to the story, was placed in connection with the dynamo. A large shark soon pulled at the hook, and a current at 200 volts was sent through the cable, but this only made the animal lash the water with fury. It was possible to raise the pressure to 750 volts, and when this had been done the shark shot out of the water almost vertically, and then fell down motionless and dead. The story adds that the negroes, who had gathered in fishing boats, seized the carcase and conveyed it to the shore to cook for a meal.

Electric Supply Cricket League.—The secretary of this League, Mr. A. W. Seabright, has sent us a list of the numbers of points scored to date by the respective clubs in the League, as follows:—

	Number of Matches played.	Points scored.
St. James's Electric C.C.	8	15
St. Pancras Electric C.C.	8	11
Kensington and Knightsbridge Electric C.C.	9	11
Central Electric C.C.	9	8
St. Marylebone Electric C.C.	5	1
Chelsea Electric C.C.	7	0

The St. Pancras Electric C.C. are the present holders of the Challenge Cup.

Quartz Lamp for Ultra-Violet Rays.—A new lamp of the mercury-vapour type, in which the tube is of quartz, has been introduced by Messrs. H. W. Cox, Ltd. As quartz, unlike glass, is completely transparent to ultra-violet rays, and can stand a much higher temperature, the therapeutic effect of the quartz lamp is very much greater than that of the earlier types, and larger surfaces can be dealt with.

The Lay Press at it Again.—This is how the *Tribune*—a paper which is in its infancy—decorates an article on life in London:—"The sixteen-candle bulbs that consume a watt an hour are not for him who earns a pound a week, when the Board of Trade unit costs from fourpence halfpenny to eightpence for every three hours of the light of which the poor are as sharply bereft as if they were prisoners in name as well as in fact." The author seems to have been labouring under a slight misapprehension, but this may well be excused in view of the elegance with which his views, whatever they may be, are concealed. We note with interest also that travellers, when they encounter in the Simplon an air shaft through which the light falls, draw a long breath, and we admire the bald-headed courage of the writer. After fully half a column of similarly gifted trash, in which he introduces an incredible number of irrelevant topics, he leaves Miss Jane East to speak for herself of her experiment in Chelsea, and us to wonder if, and why, he is paid for it.

The *Daily Telegraph* casually remarks in connection with Mr. Thwaite's system of electric culture:—"Very soon after Jablouchoff invented the electric arc . . . ." This is rough on Jablochkoff; but what about Sir Humphrey Davy?

When will the responsible daily papers, upon which the average man depends for his general information, include upon their staffs scientific experts who will save them from committing technical absurdities?

Electric Shock Fatalities.—On Tuesday a porter named Perry met his death at Harrow. While engaged in coupling carriages, he seems to have accidentally stepped on the live rail. It is stated that, in endeavouring to free himself, he fell with his face on the rail. His face was blackened by burning, while his leg was charred and his boot burnt through.

Electrochemical Notes.—A Practical Limitation of Resistance Furnaces.—In theory, the electrical resistance furnace is a very simple apparatus; electrical energy is converted into heat in the resistance material, with a conversion efficiency of 100 per cent. The only apparent limitation of heat effect is the volatilisation of the resister itself, and in the case of liquids, the inability to get a retaining cell which does not itself melt. A recent paper deals with the latter type of furnace, which, in all respects, is far more complicated than that in which the heat is developed in a central solid resistance material, such as graphite. When the current density in a liquid conductor contained in an open channel is sufficiently increased, the material begins to contract with considerable force, especially at a place where some slight obstruction is to be found. This contraction of the cross-section resembles the depression in a plastic material that has been pinched with the fingers, and the author suggests the name "pinch phenomenon" to describe this curious change. The first depression in the surface of the conductor gradually increases into a V-shaped section, and becomes deeper as the current density gets larger, and finally reaches the bottom of the channel. The current is then broken, and the liquid flows back to make contact again. In this manner a violent automatic interruption of the current, accompanied by loud crackling and much spluttering, is set up, which means that the limit of current density has been passed. It is necessary at this point to break the circuit externally to allow the parted liquids to flow together again and reach their normal level. If this precaution is neglected, the core will freeze in its divided state and cause serious difficulty in mending the break. This is an important factor in the designing of a furnace. The channel should, above all, be perfectly uniform and kept free from obstructions. Both depth and width should be made large, which means short channels, low voltages, enormous currents, or else a large capacity of the furnace. The depression will extend downwards as much as 6 in. through molten iron and cause a complete rupture.—*Electrochemical and Metallurgical Industry*, Vol. V, No. 6, 1907.

Granular Carbon Resistance Furnace.—The following is a description of an electric furnace of the granular carbon resistance type, suitable for small scale and experimental work. The bottom is composed of magnesia brick, and is surrounded with a fire-clay brick outer coat. The walls are made of the latter material, and the whole structure is held together by means of a cement composed of equal parts of fire-clay and siloxicon. The electrodes are made of Acheson graphite and are luted through the furnace walls and fixed in position by means of the above cement. The interior of the furnace is filled with crushed coke, no particular care being used in grading to a certain size. It probably averages 20 mesh, and smaller sizes are to be avoided, as they cause blowing which scatters the resister. The crucible is composed of graphite, and is embedded in the coke. This may vary in size from about 1½ to 4 in. internal diameter. New coke is very liable to blow, but after being in use for some time little care need be taken, as this undesirable feature is lost. The crucible is then heated to a very high temperature in a short time. Such a furnace as this gives very good results in the reduction of oxides to the metallic state. Where carbon is to be avoided, magnesia crucibles may be substituted for graphite, but this is necessary only when it is undesirable to increase the carbon contents of the material in hand. This type of furnace works best with an alternating current, as perfect control may be obtained by variation in the voltage by means of the field of the alternator or by means of an auto-transformer. With direct current a rheostat has to take very heavy currents, which causes a great loss of power. To get an even heating right from the start it is advantageous to pack the outside of the crucible with such a non-conducting substance as charcoal. The capacity of the furnace is from 30 to 35 kw.—*Electrochemical and Metallurgical Industry*, Vol. V, No. 6.

Manufacture of Iron in Sweden.—A report was presented to the Swedish Government a short time ago by Mr. J. A. Brinell upon the possibility of reducing the iron ores found at Norrbotten, in Sweden, to the metallic state in the country itself, in the course of which the author deals with the question of smelting Swedish iron ores in the electric furnace. Mr. Brinell comes to the conclusion that the existing iron works in Sweden could not treat these phosphoric ores in large quantities, owing to the expense of carriage, and that if any new works were to be erected on the coast, they would have to export the greater part of their product, although they would not be able to compete with firms outside Sweden working Scandinavian iron ores, unless they could obtain their ores more cheaply than their foreign rivals. Mr. Brinell considers that as long as the Swedish iron trade is dependent on the importation of fuel it is not possible to create a home industry of equal magnitude to that based on the exported Swedish ore. As regards electrical methods, Mr. Brinell views them as being still in the experimental stage, and he observes that even if they could be successfully operated they would only reduce to one half the present consumption of fuel. There is no probability that a large iron industry could be created based on the use of peat, as long as the only method for removing the moisture in natural peat depends on air drying. Finally, the author states that no method is yet known by which the ores found at Norrbotten could be reduced on a large scale, and even if such methods were discovered, many years would be consumed before they could be operated to any extent.

The Lighting of Class Rooms.—Addressing one of the largest meetings held in connection with the International Congress on School Hygiene in London on Wednesday, Sir Aston Webb, R.A., F.R.I.B.A., dealt with the subject of lighting and ventilation of class rooms. He remarked that the artificial lighting of class rooms hardly came under their consideration to-day, but it was of great importance where much evening work was done. Carefully regulated incandescent electric lighting was the best, and greatly simplified the ventilation. Gas was better avoided. Perhaps the best illuminant was composed of inverted arc lights with the room lit by reflection from the ceiling; but it was extravagant in current. Single incandescent lamps, equally distributed over the ceiling, gave a pleasant and well diffused light. Groups of lamps in electroliers should be avoided in class rooms. One 8-c.p. lamp, if not hung too high, should light sufficiently 24 ft. superficial of floor area.

London Power Supply.—The Companies' Bill Withdrawn.—On Wednesday night, in the House of Commons, the withdrawal of the above Bill was announced, it being impossible so late in the Session for it to be passed. Mr. F. L. Harris, in making the announcement, said that the Board of Trade had consistently opposed the principles of the Bill, although electrical enterprise in London was in an intolerable position. The existing position of the supply of electricity was uneconomical in the extreme, resulting in a duplication in almost every area, so that the cost of generation was enormously increased, to the detriment of the consumer. In the event of breakdown, no district could help another. What was wanted was a wholesale scheme to definitely lay down some principles which could be adopted, and which would satisfy not only the consumer and the ratepayer, but the London County Council and various local authorities and the electric lighting companies. He suggested the constitution of some authoritative committee to go into the question, and said the President of the Board of Trade would find that the companies interested in the present Bill had every desire to meet the right hon. gentleman in any proposals he had to make.

Mr. Lloyd-George thought the hon. member had taken the only possible course under the circumstances. His own opinion was that it was impossible to arrive at any solution of the problem until the parties interested could come to some common understanding on some general principles. He did not think that was impossible. It was really a business proposition, but he did not see any hope at the present moment of the parties coming together, though within the next few months something might be done.

Appointment Vacant.—Royal Technical Institute, Salford.—Instrument maker and lecture assistant (£100). See "Official Notices" to-day.

Meeting of Creditors.—A meeting of the creditors of Messrs. Lea & Warren, electrical engineers, Kettering, was held in London recently. According to a Northampton paper, a statement of affairs was submitted by Messrs. A. C. Palmer & Co., which showed unsecured creditors £5,187, and total debts of £5,535. The assets showed a deficiency of £2,807. The deficiency account was also submitted, and showed that such deficiency was mainly attributable to the serious loss involved in connection with the Long Grove Asylum contract from the London County Council. An offer was submitted on behalf of the debtors for a composition of 8s. in the pound with the last instalment secured. The general feeling being expressed, however, that the last two instalments should be secured, the following resolutions were passed without dissent:—"That a composition of 8s. in the pound be accepted, payable by four equal instalments at 3, 6, 9 and 12 months (by composition bills or notes), provided the last two instalments are secured to the satisfaction of the following committee within 14 days; that should either the debtors fail to find satisfactory security, the creditors fail to agree to the resolutions, or any proceedings be taken against the firm, then the debtors execute an assignment for the benefit of creditors with the same gentlemen as a committee of inspection; that the committee consist of the representatives of the three largest creditors, viz., Stamford, Spalding, and Boston Banking Co., Ltd.; the General Electric Co., Ltd.; Messrs. Gent & Co., Ltd.; and that should a deed be necessary, Mr. A. C. Palmer be appointed trustee thereunder."

Parliamentary.—The Speaker has reported that the Royal Assent has been given to the following Bills:—Telegraph (Money) Act, 1907; Electric Lighting Confirmation (No. 3) Act, 1907; Tramways Orders Confirmation Act, 1907; Sheffield Corporation Act, 1907; Middlesbrough, Stockton-on-Tees and Thornaby Tramway Act, 1907; North Metropolitan Electric Power Supply Act, 1907; Richmond (Surrey) Electricity Supply Act, 1907; Manchester Corporation Tramways Act, 1907; Coventry Corporation Act, 1907.

In the House of Commons on August 2nd the Aberdeen Corporation Electricity Bill passed its third reading.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. R. U. Bailey, of the Newcastle-on-Tyne Electric Supply Co., Ltd., has been appointed shift engineer, and Mr. George Scott, of the Handsworth U.D.C. electric supply department, boiler house foreman, at the Summer Lane Electricity Works of the Birmingham Corporation.

On Saturday, July 27th, at All Saints Church, Branksome, Mr. Gerard Ogilvey Nevile, son of the late Mr. H. W. Nevile, of Manchester, and formerly assistant engineer to the Bournemouth

and Poole Electricity Supply Co., Ltd., now with Messrs. J. G. White & Co., Ltd., was married to Miss Eila Winifred Doyne Finch, niece of the Rev. C. Doyne, Vicar of All Saints, Branksome. Mr. Nevile has been appointed assistant engineer to the United Electric Tramways of Monte Video, Ltd., and sails with Mrs. Nevile for Monte Video on September 6th.

Dewsbury T.C. has appointed Mr. W. E. Rogers, of Warrington, as chief assistant electrical engineer at a salary of £150 per annum, and Mr. E. Milner, of Dewsbury, as shift engineer. For the former post there were 168 applicants.

Tramway Officials.—The Eastbourne T.C. has been recommended to increase the salary of Mr. P. Ellison, general manager of the motor-'buses, from £250 to £275 per annum.

The employés at Dartford of Messrs. J. G. White & Co., lessees of the tramways, have presented a watch to Inspector F. Twort, who is leaving to take up an appointment in New Zealand.

General.—Mr. Thomas Parker announces his change of address from 1b, Chapel Street, Edgware Road, W., to Croft House, Rosecroft Avenue, Hampstead, N.W.

Obituary.—Joseph Crosland.—The death has occurred, at the age of 35 years, of Mr. Joseph Crosland, works manager for the British Insulated and Helsby Cables Co., Ltd., Helsby. He had been with the firm for 19 years, having commenced at Helsby as an apprentice.

A. J. Brooking.—The death occurred, on the 2nd inst., of Mr. Albert John Brooking, of 25, Richmond Road, Exeter. Deceased had for the last 10 years carried on business as an electrical engineer in the city.

NEW COMPANIES REGISTERED.

Chisholm Manufacturing Co., Ltd. (94,410).—This company was registered on July 31st, with a capital of £10,000 in £1 shares, to acquire the business carried on by C. H. Williams and G. Chisholm, at Birmingham, as the Chisholm Manufacturing Co., to acquire patents granted to G. Chisholm (1) No. 7,748 of 1904, for improvements in electric switches; (2) No. 16,216 of 1904, for improvements in Portiere rods; (3) No. 10,727 of 1905, for improvements in plugs for sink wastes; and (4) No. 17,671 of 1905, for improvements in sanitary socket accessories, to develop and turn to account the same, and to carry on the business of brassfounders, electricians, manufacturers of electrical accessories, appliances and machinery, &c. The first subscribers (each with one share) are:—C. H. Williams, Devonshire House, Forest Road, Moseley, manufacturer; W. Headley, Edwina Lodge, Moseley, manufacturer; G. Chisholm, 96, Langley Road, Small Heath, manufacturer; A. H. Cooper, Normanhurst, 244, Alcester Road, Moseley, manufacturer; A. E. Pimbury, Parklands, Alcester Road, Moseley, manager; T. Gardiner, Eastbourne, Mansel Road, Small Heath, manager; and E. S. MacLaren, Ivy Cliffe, Mansell Road, Small Heath, clerk. No initial public issue. The first directors are C. H. Williams and G. Chisholm (managing director); qualification, 100 ordinary shares; remuneration of G. Chisholm, £250 per annum; of other directors as fixed by the company. Registered office, Providence Works, Fleet Street, Birmingham.

Foster Arc Lamp and Engineering Co., Ltd. (94,371).—This company was registered on July 29th, with a capital of £20,000 in £1 shares (5,000 6 per cent. cumulative preference), to adopt an agreement with M. V. Ely, E. R. Grote and E. Dobson, and to carry on the business of arc lamp manufacturers, electric engineers, electric lighting contractors, cable manufacturers, electric fittings, storage battery and carbon manufacturers, &c. The first subscribers (each with one share) are:—M. V. Ely, 26, Hill Road, Wimbledon, engineer; E. R. Grote, Worple Road, Wimbledon, electric engineer; E. Dobson, Waldon Castle, Torquay, electric engineer; J. B. Ely, Thetford Road, New Maldon, gentleman; T. Ely, Powis Lodge, Bickley, gentleman; Mrs. E. Grote, Church Lane, Merton Road, Surrey; and J. Gilley, 60, Ranelagh Gardens, Ilford, gentleman. No initial public issue. The number of directors is not to be less than two or more than five: the first are M. V. Ely and E. R. Grote (managing directors) and E. Dobson. E. Dobson represents the holders of the preference shares. Qualification, 500 shares; remuneration of managing directors not less than £234 each per annum; of E. Dobson £208 for first year; and afterwards not less than £234 per annum (plus a sum sufficient to discharge income tax in each case). Registered office, Worple Arcade, Worple Road, Wimbledon.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Scottish House-to-House Electricity Co., Ltd. (29,232).—This company's annual return was filed on May 28th, 1907, when 970 ordinary and 100 founders' shares had been taken up out of a nominal capital of £100,000 in £5 shares (14,900 ordinary, 5,000 preference and 100 founders'). £5 per share has been called up on each, resulting in the receipt of £5,350. £108 has been received on 54 forfeited shares. Mortgages and charges: £100,318 1s. 4d. An additional charge for £500, dated July 8th, 1907, has been registered. Property charged: The company's undertaking and property, present and future, including the Coatbridge and Airdrie undertakings. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C.

British Aluminium Co., Ltd. (41,104).—This company's annual return was filed on July 3rd, when 20 000 6 per cent. preference, 40,000 7 per cent. preference, 40,000 ordinary and 20,000 "conversion" shares had been taken up out of a nominal capital of £1,300,000 in 60,000 6 per cent. preference, 40,000 7 per cent. preference, and 40,000 ordinary shares of £5 each, and 20,000 "conversion," and 40,000 "1908 conversion" shares of £10 each. £5 per share has been called up on 20,000 6 per cent. preference, 33,540 7 per cent. preference, and 38,001 three-fifth ordinary, and £4 per share on 20,000 "conversion," resulting in the receipt of £537,708. £42,292 is considered as paid on 6,460 7 per cent. preference, and 1,998 two-fifth ordinary. Mortgages and charges: £300,000 5½ per cent. Loch Leven debentures, and £241,420 5 per cent. debenture stock.

United River Plate Telephone Co., Ltd. (23,654).—A trust deed, dated June 14th, 1907, to secure £300,000 debenture stock, has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: River Plate Trust Loan and Agency Co., 52, Moorgate Street, E.C.

North Eastern Electrical Stores, Ltd. (Newcastle-on-Tyne), (94,048).—A first debenture, dated July 10th, and a second debenture, dated July 12th, 1907, securing £175 and £165 respectively (both with 5 per cent. interest), charged on the company's undertaking, and property, present and future, including uncalled capital, have been registered. Holder: A. Dunbar, Stanger Road, South Norwood, S.E.

Harwich Electric Lighting and Tramways Co., Ltd. (66,783).—This company's annual return was filed on May 25th, when 7 shares had been taken up out of a nominal capital of £50,000 in £1 shares. No calls have been made. Mortgages and charges: Nil.

Bi-Centric Insulating Co., Ltd. (Birmingham). — Issue on July 11th of a 5 per cent. debenture for £50, part of series created February 21st, 1907, to secure £200, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Holder: R. S. Mason, 7, Anderton Road, Sparkbrook, Birmingham. Previously issued of same series: £150.

Engineering Instruments, Ltd. (London), (66,427).—Issue on July 15th of £590 5 per cent. debentures, part of series created November 30th, 1906, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £2,410.

W. Lucy & Co., Ltd. (Electrical and general engineers, Oxford), (51,908).—A memorandum of satisfaction in full of debentures dated November 12th, 1901, securing £1,500, has been filed.

Consolidated Supply Co., Ltd. (Electrical engineers, London), (85,888).—Issue on July 1st of £225 5 per cent. debentures, part of series created July 18th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £11,500.

Bridgwater and District Electric Supply and Traction Co., Ltd. (75,429).—This company's annual return was filed on July 23rd, when 12,749 shares had been taken up (in addition to 100 which have been forfeited) out of a nominal capital of £15,000 in £1 shares. £3,877 has been received, including £10 paid on the said forfeited shares, and £8,882 is considered as paid. Mortgages and charges: £12,000.

J. C. Lyell & Co., Ltd. (80,797). — This company's annual return was filed on June 13th, when 500 ordinary and 619 preference shares had been taken up out of a nominal capital of £2,000 in 500 ordinary and 1,500 preference shares of £1 each. £1 per share has been called up on the preference, resulting in the receipt of £619. £500 is considered as paid on the ordinary. Mortgages and charges: Nil.

Siemens Electric Appliances, Ltd. (75,102).—This company's annual return was filed on July 9th, when the entire capital of £25,000 in 250 shares of £100 each had been taken up. £100 per share has been called up on seven and £30 per share on 243 shares, resulting in the receipt of £7,990. Mortgages and charges: Nil.

Holloway Electric Supply Co., Ltd. (53,172).—Issue on June 29th of £3,200 5 per cent. debentures, part of series created December 28th, 1900, to secure £20,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £15,000.

Camborne Electricity Supply, Ltd. (57,950).—This company's annual return was filed on July 27th, when 607 shares had been taken up out of a nominal capital of £10,000 in £1 shares; £605 has been received and £2 remains in arrears. Mortgages and charges: Nil.

Eastern Extension, Australasia and China Telegraph Co., Ltd. (7,224).—This company's annual return was filed on June 5th, when the entire capital of £3,000,000 in £10 shares had been taken up and paid for in full. Mortgages and charges: £752,400.

D Santoni & Co. (1906), Ltd. (electrical engineers, London), (89,277).—Issue on July 20th of £220 6 per cent. debentures, part of series created May 31st, 1907, to secure £2,750, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £2,420.

British Ever-Ready Electrical Co., Ltd. (London), (71,891).—Issue on July 23rd of £500 5 per cent. debenture, part of series created March 30th, 1904, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £6 000.

Lowden Electric Lamp Co., Ltd. (53,470).—A return of allotments filed June 11th, 1907, shows that a further 70 ordinary, and 400 5 per cent. preferred ordinary shares have recently been allotted for cash. In December, 1906, 2,830 shares were taken up (1,030 for cash, and 1,800 credited as fully paid) out of a nominal capital of £3,000 in £1 shares. In March, 1907, the capital was increased by the creation of 1,000 new shares of £1 each.

Yorkshire (West Riding) Electric Tramways Co., Ltd. (84,167).—Particulars of £30,000 debentures, created by resolution June 28th, 1907, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. Property charged:—The company's undertaking and property, present and future, including uncalled capital, subject to any outstanding first debenture stock of a series of £400,000. No trustees.

Leicestershire and Warwickshire Electric Power Syndicate, Ltd. (72,274).—Issue on July 9th of £650 6 per cent. debentures, part of series created same date, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

North Wales Power and Traction Co., Ltd. (78,193).—A deed dated June 28th, 1907 (modifying a trust deed dated August 15th, 1905, securing £150,000, reduced by deed of modification to £80,000), has been registered. Property charged:—Certain freehold land and hereditaments, shares, and debenture stock in the Portmadoc and South Snowdon Railway Co., or proceeds of sale thereof to which the company may become entitled under an agreement dated August 9th, 1905; an agreement dated August 8th, 1905, relating to payment of moneys due upon certain shares in the company, and the company's other assets, present and future, except uncalled or unpaid capital (if any). Trustees: Law Debenture Corporation, Ltd., 41, Threadneedle Street, E.C.

Standard Electric Co., Ltd. (68,643).—This company's annual return was filled on July 24th, when 3,077 preference and 5,000 ordinary shares had been taken up out of a nominal capital of £10,000 in 5,000 preference and 5,000 ordinary shares of £1 each. £1 per share has been called up on 4,177, and 10s. per share on 400, resulting in the receipt of £4,377. 3,500 shares are considered as fully paid. Mortgages and charges: £3,500.

Fladbury Electric Light and Power Co., Ltd. (63,942).—This company's annual return was filed on June 7th, when 855 shares had been taken up and paid for in full out of a nominal capital of £2,000 in £1 shares. Mortgages and charges: £300.

Urban Electric Supply Co., Ltd. (57,986).—This company's annual return was filed on June 27th, when the entire capital of £650,000 in 80,000 ordinary and 50,000 preference shares of £5 each had been taken up and paid for in full. Mortgages and charges: £275,000.

Twickenham and Teddington Electric Supply Co., Ltd. (57,984).—This company's annual return was filed on June 27th, when 127 shares had been taken up out of a nominal capital of £25,000 in 5,000 shares of £5 each. £5 per share has been called up, resulting in the receipt of £635. Mortgages and charges: Nil.

CITY NOTES.

Central London Railway Co.

The report for the half-year ended June 30th, stated that the capital expended was £6,351, the principal items being for an additional cooling tower and water supply at Shepherd's Bush. There was a decrease of £15,599 in the receipts, and of £4,372 in working expenses; but rates and taxes had required £355 more. The balance was £74,950, or £11,227 less than in 1906. The passengers numbered 20,260,871, a decrease of 2,075,618 and £16,739. After providing for interest on debenture stock and other payments, there remained a balance of £70,891. The directors recommended a dividend on the undivided ordinary stock at the rate of 3 per cent. per annum for the half-year, and the preferred ordinary stock at the rate of 4 per cent. per annum for the half-year. Dividend on the deferred ordinary stock was not payable until the result of the year's working had been ascertained; the balance remaining, £31,423, was therefore carried forward. After careful observation and inquiry, the directors decided, though with much regret, to abandon the system of charging a uniform fare, and to adopt the increased charge of 3d. for passengers travelling beyond seven or eight stations, adhering to the 2d. fare for all lesser distances. The alteration came into effect on July 1st last. It was proposed that a conference or committee, to consist of representatives of the Metropolitan, the District, and the North London Railways, the various tube and tram undertakings, and the omnibus and motor-'bus companies, should be established for the purpose of dealing with questions affecting their common interests, and of adjusting differences that might from time to time arise. The company's Bill to authorise the construction of an additional line into the depôt yard at Shepherd's Bush, on which it was proposed to provide a station at the entrance to the Franco-British Exhibition, had received the Royal Assent.

Sir Henry Oakley presided on Wednesday over the twenty-fourth ordinary general meeting of this company held at the Holborn Restaurant.

In moving the adoption of the report, the Chairman said that there were 2,739 proprietors, which was 34 more than there were last December. The capital expenditure during the year had amounted to £6,351, of which the principal items were for a cooling tower and water supply at Shepherd's Bush. They had reduced the expenses of working, and the cost of coal also showed a decrease. They had spent £546 for the construction of supplementary plant at the Post Office station. The capital account was in debt to the extent of £5,377, but their demands for new capital were not very great, and they still had powers to issue £254,000, of which £50,000 was easily available. The directors did not contemplate issuing any new stock owing to the state of the money market. They had been to Parliament, and obtained powers to construct an additional line at their Shepherd's Bush Station. At present they only had a single line running to the works and yards, and for a very long time the directors had recognised the necessity of having another line, as had the existing line been blocked in any way, it would disorganise the service. As they were aware next year there was to be an exhibition called the Franco-British Exhibition, and it was proposed to build a station on the proposed site, so as to run the passengers right outside the Exhibition. That arrangement was, of course, subject to their being able to come to satisfactory terms with the promoters of the Exhibition. If the demands of the neighbourhood showed that it would be profitable to keep the station open after the Exhibition that certainly would be done. Turning to the traffic side of the accounts, as they knew the company had been going through a troublesome period. There had been a large diminution in the traffic carried by all the tube railways during the past six months, not through any deterioration of the service, nor had there been any accidents or any material detention in the services. The company had been compelled, most reluctantly to higher the fares, and thus abandon the universal fare. The diminution in their traffic receipts had been a steady and progressive one, and represented about 2 millions, or 10 per cent. in the number of passengers, and the total loss in revenue from direct fares was £16,000. That amount had been slightly lessened by sundry items. The expenses had been reduced by £4,700, but unfortunately they had to pay an additional £370 for rates and taxes, which resulted in a saving of about £2,000. The whole cause of the falling off in traffic was due to increased competition. There were over 20 per cent. more omnibuses running between Marble Arch and Holborn than there were a year and a half ago. The District Railway had also regained some of their former passengers, owing to their improved service, but where they had lost most was in what they called the shopping centres. At Marble Arch and Tottenham Court Road the diminution represented something like 15 per cent. and 18 per cent. of the returns. Persons could travel from the City to the Tottenham Court Road for a 1d., whereas their company charged 2d., but he noticed that the company who had promoted the absurd low fare had not benefited, as the company had lost over £4,000, as compared with the previous half-year. Sir George Gibb had done his best to remedy the evil, and had called together all those concerned in the means of providing facilities for transit, to consider whether it was a reasonable and sensible thing to go on charging fares which were absolutely unremunerative. He (Sir Henry) gladly concurred with Sir George Gibb in his views, and thought it was time that an end was put to the absurdly low fares now being charged. A committee had been formed to go into the whole matter to see if by mutual working some other basis could be arrived at which was more equitable. Nothing really had been practically settled, but they hope that the result of their conferences and their deliberations would be that they would not have to take any drastic steps to protect their interests. Their company had, however, been obliged to recognise in the end that their 2d. fares were not sufficiently remunerative, and that they required modification. In the face of the new competition, they saw it was impossible to charge 2d. for short distances as well as for the longer routes, and therefore they had found it necessary to alter the fares. As a result of the extra charge of 1d., there was a difference of £60 and £70 a day in the receipts, which they considered satisfactory, and the directors hoped that the gain in one place would make good the loss in other places. The diminution in receipts was now in a downward ratio, and they hoped that that was a hopeful sign for the future, and that the little trouble they were now having would soon pass away. As regards the working as a whole, they were not satisfied; unfortunately, they had to propose a dividend of 1 per cent. less than in the previous years, and although that represented £15,000 less, they would be paying 3 per cent. dividend and carrying forward £25,000 instead of £14,000 only, so that although it required £15,000 to pay a 1 per cent. dividend, they practically had £11,000 of it in hand. He thought, therefore, on the whole that, considering the circumstances of increased competition and the general tendency of increased working expenses, they had not done badly. They hoped to get additional revenue from the opening of the Charing Cross and Euston and Hampstead Railway, which was connected with their line at Tottenham Court Road. In conclusion, he referred with regret to the death of their engineer, Sir Benjamin Baker, whom he had known for many years.

Lord Rathmore seconded the motion.

Replying to various questions by the shareholders, the Chairman said that he had been in communication with Sir George Gibb as to the advisability of having a better service of through booking, and if terms could be satisfactorily arranged no doubt the company would start a larger system of through bookings. The reference of the auditor's report to the appropriation of the locomotive suspense account, was accounted for by the fact that when they first started the line they had heavy locomotives, which cost them between £70,000 and £?0,000. Those locomotives had been replaced by a lighter style of engine, and consequently the locomotives represented a dead loss, and they could not determine who was to bear that loss, the present shareholders by taking it out of revenue or future shareholders. They had decided, however, to break the engines up and sell them in parts, but even then there would be a deficiency of £50,000. There was no loss on the workmen's fares, but they did not get so large a profit as they could reasonably expect.

The report was then adopted.

Shanghai Electric Construction Co., Ltd.

An extraordinary meeting of this company was held on Wednesday, at 54, Old Broad Street, Sir Alfred Dent presiding.

The Chairman said the only business before the meeting was to confirm a resolution passed at the meeting held on July 18th. The object of the motion was to split up each of the existing £1,000 shares into 100 £10 shares, and, further, to provide for the issue of share warrants to bearer to those who desired them in exchange for their present certificates.

The resolution was formally moved by the Chairman, seconded by Mr. Asquith, and the proceedings terminated.

Aluminium Corporation, Ltd.

The statutory meeting of this company was held on Wednesday at Winchester House, Sir James Sivewright (Chairman) presiding.

The Chairman, in moving the adoption of the report, said that the meeting was purely a statutory one. The company, as they knew, was formed according to the prospectus, which was to acquire certain freehold property and water rights of a place in North Wales for the development and production of aluminium. The original idea was to lease the premises, but after consideration the directors thought that it would be far more economical to obtain the freehold of the buildings, and they had paid the sum of £55,000 for the freehold rights. The extent of the premises was 1,300 acres, which included the area of Lake Eagure, which covered 86 acres. They also received a rental of £528 for land, and they had no doubt that that land would considerably increase in value in the future. The works at present were in active course of construction under the contract arranged with Messrs. Mott & Dennett, and according to the terms they were to complete these works in 12 months, and the whole of the undertaking in two years. Desirous as they were of getting power as quickly as possible, they had made arrangements with the North Wales Electric Power Co. for the supply of 600 kw., or an equivalent of 800 h.p. of current at a price which they considered very satisfactory. After consideration the directors had increased that supply to 1,200 kw., or 1,600 h.p., so that instead of having 6,000 h.p. available as stated in the prospectus, they would have, when all the works were completed, nearly 7,000 h.p. available. Having in their minds that it was the best thing to get the cheapest way of producing the metal, the company had made arrangements with the Newcastle Electric Supply Co. for a supply of current for power purposes at Tynemouth. They hoped to get from that some 4,000 kw. per annum at a price which they considered satisfactory. The directors had secured a plot of land almost adjoining the works of the electric company, and the construction of the buildings was now going on. If the North-

Eastern Railway Co. fell in with their idea as regarded price they hoped to have a railway siding built alongside of the works which would be of a great advantage. As to raw materials, they had entered into contracts which would come into effect as soon as they were capable of producing aluminium. He saw no reason why they should not be in a position to turn out the metal at the end of this year or early in 1908. They did not anticipate any drop in the somewhat high prices which now ruled for the metal. The demand was largely in excess of the supply, and the merits of the article were such that they had no doubt that their company would be a prosperous concern. The field for aluminium was so large that he thought the shareholders in that company had good prospects in the future.

Mr. Hillier seconded the motion, and the report was adopted.

Brush Electrical Engineering Co., Ltd.

From reports appearing in the daily Press, we gather that on August 2nd special meetings of this company were held, at which resolutions were passed—there were a few dissentients—reducing the capital from £660,000 to £489,512 by cancelling capital lost or not represented by available assets, to the extent of 13s. 4d. per share upon the issued shares, and for increasing the non-cumulative dividend on the preference shares from 6 per cent. to 7 per cent. We were not represented at the meetings, because in response to a telephone message we were given to understand that the proceedings were not to be open to the Press. From the report in the *Times*, we gather that Lord Vaux of Harrowden, who presided, said that at their general meetings for some years a desire had been expressed that a reduction should be made in the figures of the item for patents and good-will, &c. It was as well to make it clear that this item did not represent the result of a valuation, but the price which was paid when the business was purchased. Inasmuch as the ordinary and preference shareholders participated equally as to capital, it was proposed that in this reduction they should be upon the same footing, and that the ratio should be 13s. 4d. per share on each class. The ordinary shareholders were asked to permit of an increase in the amount to be paid as dividend on the preference shares of 1 per cent., or from 6 per cent. to 7 per cent. upon the reduced capital. The preference charge now took a prior amount of £18,000 per annum, whereas after the reduction had been carried out the annual preference charge for a 7 per cent. dividend would only be £14,000. The resolution was seconded by Mr. F. M. G. Cornwallis-West, and carried.

"An extraordinary general meeting followed, for the purpose of passing by the whole body of shareholders a similar resolution. The chairman, in moving the resolution, said that by reducing the capital by one-third the face value of each class of share would be £1 6s. 8d. After explaining the proportions of new shares which would be allotted to the holders of existing shares, he said that the proposed sub-division of the shares would facilitate the exercise of the option to the preference shareholders to convert a proportion of their holding (that was to say, one-fourth of it) into ordinary shares. Mr. Cornwallis-West seconded. Mr. John Howlett said that the shareholders suffered a reduction of the capital some years back, and he protested against their undergoing a further reduction now. Mr. Cathcart, in supporting the resolution, expressed the opinion that the directors were following a wise policy. Other shareholders having spoken, the chairman replied, and said that it was essential that the proposal should be carried out, having regard to the serious depreciation which they had to face. Eventually the resolution was carried, with about half-a-dozen dissentients."

According to the *Financial News*, at the first meeting, Mrs. Mainardi complained that the preference shareholders were being too liberally treated, and the chairman, in reply, "said that it was necessary to gild the pill, because the preference shareholders, unless they were offered some tangible inducement, would not agree to the reduction of capital, and while they benefited by getting their dividend increased from 6 per cent. to 7 per cent., the actual cost to the company would be £4,000 a year less, and therefore it was a distinct advantage to the ordinary shareholders to agree to the scheme."

Liverpool Overhead Railway Co.

The report of the directors to the 38th ordinary half-yearly general meeting of the shareholders, to be held at Liverpool on the 13th inst., shows that for the period ending June 30th, 1907, the gross revenue receipts amount to £38,246 10s. 4d., and the working expenses to £30,035 6s. 7d. The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31, 1905.	Half-year ending June 30, 1906.	Half-year ending Dec. 31, 1906.	Half-year ending June 30, 1907.
First class	625,430	608,870	630,562	615,690
Third class (including tramways) ..	3,346,980	3,086,008	3,362,441	3,190,871
Workmen (special return tickets) ..	1,645,312	1,800,227	1,540,550	1,617,094
Total	5,617,672	5,445,100	5,533,553	5,423,595

The above figures show a decrease in the total number of passengers carried of 21,505, but the total receipts have increased £463, while the expenses have been reduced by £265. The through traffic to Southport and Aintree in connection with the Lancashire and Yorkshire Railway Co. continues to make slow but steady progress. The directors regret to have to report the retirement of Mr. Richard Hobson, who has rendered to the company most valuable services.

Revenue Account.		
Receipts from passenger traffic amount to	£37,234	16 5
Miscellaneous receipts and interest	1,011	13 11
	£38,246	10 4
Less working expenses	30,035	6 7
	£8,211	3 9
Deduct interest on mortgage debentures, and on calls paid in advance	4,329	8 2
	£3,881	15 7
Add balance brought forward, December 31st, 1906..	4,246	9 6
Leaving available for dividend	£8,128	5 1

Out of this balance the directors recommend the declaration of a dividend of 5 per cent. per annum on the preference shares (less income-tax), leaving a balance of £4,452 8s. 1d. to be carried forward to next half-year. The transfer books are closed up to Tuesday next.

Great Northern and City Railway Co.

The directors in their half-yearly report state that the total revenue receipts for the six months ending June 30th last amounted to £49,838, and the cost of working to £24,616, being at the rate of 49·39 per cent. After providing for interest on debenture stock and other charges, and setting aside £500 to form the nucleus of a renewal fund, the directors recommend that the balance of £1,035 be carried forward to the next account. The number of passengers carried for the six months under review, including season ticket holders, was 8,269,435, as against 8,087,740 for the corresponding period last year. The number of local season tickets issued during the half-year was 3,995, as against 3,131 for the half-year ending June 30th, 1906. The number of three-route season ticket holders using the company's line during the past half-year was 2,735. The following table shows the number of passengers carried, including estimated number of journeys made by season ticket holders, and the traffic receipts for each half-year, since the opening of the line:—

	Half-year ending June.		Half-year ending December.	
	Passengers.	Traffic receipts.	Passengers.	Traffic receipts.
1904	2,891,648	£18,158*	5,929,641	£34,745
1905	7,527,634	43,486	7,383,383	42,933
1906	8,087,740	46,560	7,901,923	45,564
1907	8,269,435	46,920	—	—

* Line opened for traffic, February 14th, 1904.

Warrants for interest on "A" and "B" shares for the period from December 31st, 1906, to February 14th, 1907, will be posted on the 15th inst.

The half-yearly meeting was held on Friday of last week at Westminster Palace Hotel, the Earl of Lauderdale presiding.

In moving the adoption of the report, the Chairman said they would notice that the traffic had increased, but in not so great a proportion as in previous years. The total number of passengers carried during the six months was 8,269,435, as against 8,087,740 for the corresponding period, an increase of 181,695; while the revenue was £40,920 as against £40,560, an increase of £360. The gross amount received totalled £49,838, as compared with £49,390, an increase of £448. Had they not had to reduce their fares so as to meet surrounding competition, they would no doubt be earning a much larger revenue. They carried a large number of 1d. fares, and many persons travelled over two miles for that sum. The directors did not believe that the tramways, which were constructed at infinitesimal cost as compared with the capital cost of their line, were run at a fare which paid, and they trusted that as soon as a careful investigation could be made of the accounts, those responsible for their working would see that they were arranged on a remunerative basis, so as to allow of fair competition. The company found itself in the position of working only to pay off fixed charges and for the benefit of its employés, and from any point of view the service, which was a thorough and efficient one, was not a paying concern. A remarkable feature of the accounts was the increase in 1d. fares and decrease in 2d., with the result that while the number of passengers carried had increased 2·2 per cent. the traffic revenue had only gone up 0·75 per cent. Considering the enormous amount of competition that the company had to face, the directors thought they had done well in showing an increase in the passenger traffic—the number of passengers per car-mile being 7·42 as compared with 7·59, and per train-mile 23·2 as against 28·2. That decrease in the last figure was accounted for by the better train service. With reference to the rolling stock, the whole of the original coaches had been fitted with additional lamps, thus adding to the comfort of the passengers. The working expenses amounted to 49·39 per cent. of the receipts, which they considered satisfactory. The capital expended during the year totalled £5,364, of which £1,932 was accounted for by equipment of stations, &c. They had to go to Parliament this year to get an extension of time for their powers for prolonging the line to Lothbury. The Bill was opposed by the City Corporation in the House of Commons Committee, but on the Bill reaching the House of Lords, wiser counsels prevailed, and they asked the company to make certain alterations in the entrances

and exits to the station at Lothbury. The company were willing to do that, and the Corporation withdrew their opposition. They only regretted that the Corporation had not asked for the alteration earlier in the Committee stage, and thus saved the company, who were large ratepayers in the City, a large amount of money, which had been wasted in the committee rooms.

Mr. CHARLES STEEL seconded the motion, and the report was adopted.

Chilian Electric Tramway and Light Co., Ltd.

THE ninth ordinary general meeting of shareholders of the above company was held at London Wall Buildings on Thursday last week under the chairmanship of Sir Julius Wernher.

In moving the adoption of the report (see ELECTRICAL REVIEW, August 2nd, p. 191), the CHAIRMAN said that the year under review had been the most disappointing since the inception of the company. The damaging effect caused to the property by rioters had hardly been overcome, when they had a partial breakdown of machinery at the power station, which seriously crippled the tramway service, and these drawbacks culminated in a serious earthquake, which led for some time to a great dislocation of their whole business. It was not surprising that under circumstances of so exceptional a character the accounts showed the meagre result of a profit of £12,963. This profit, with the sum of £21,288 standing to the credit of last year's profit, was absorbed by the payment of interest and the redemption of debentures, and, in fact, the new year started with a balance of £2,447 on the wrong side. Turning to the brighter side of the picture this year, they had reached normal conditions, and if the six months just gone could be taken as a criterion of the rest of the year, their prospects were exceptionally favourable, and the results they would achieve would more than counterbalance last year's failure. Both the tramway service and the lighting business showed steady and healthy extension, and so great was the demand on the available power that they might have to face an immediate future addition to the machinery. As the company could not afford to risk breakdowns and wait for the completion of the hydro-electric works near Santiago on the Canal San Carlos at present under construction by the D.U.E.G., of Berlin, a favourable contract had already been made with that company for the supply of power from these works to enable them to shut down their steam power station, and bring about considerable economies in the future working costs. A feature of great importance was the prolongation of the company's concession for 25 years so extending the life of the franchise to 1953. The municipality of Santiago and the company were at present engaged in the revision of the tariff, and although the demands of the municipality presented many onerous conditions quite unacceptable by the company, he had no doubt that with a give-and-take policy on both sides, the negotiations would be ultimately carried through to a successful termination. He could only add their thanks to the staff of the company for the service they had rendered under exceptionally difficult circumstances.

Sir CHARLES EUAN-SMITH seconded the motion, which was carried without discussion.

Thomas Parker, Ltd.

THE thirteenth annual meeting was held at Wolverhampton last week, under the presidency of Alderman C. T. MANDER, chairman of directors.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW July 26th, page 143), said the directors had gone carefully through the points put before them last year, and they found that all their predictions had been amply fulfilled. They had been able again to show a good figure on the right side of the balance-sheet, and to carry a profit of over £18,000. For the greater part of this they must thank the managing director for his fortunate discovery of a new principle in centrifugal pumps. After the tests they were convinced that there were great possibilities in the invention. The result was that they decided to form the Rees Roturbo Development Syndicate, so as to take over from Mr. Rees his rights in those patents, and take away all monetary risks in their development from Thomas Parker, Ltd., but, at the same time, by giving Thomas Parker, Ltd., the sole licence in Great Britain for the manufacture of all Roturbo machinery to secure full advantages for the shareholders if the pump turned out all that they expected of it. There was no doubt they had made an exceptionally good bargain, and after writing off all formation and preliminary expenses of developing the pumps in the works, they had a block of 17,800 Roturbo shares in the balance-sheet taken at par. As most of the Roturbo shares sold for Thomas Parker, Ltd., had been sold at par, and the last sales had been at 22s. 6d., there was no doubt that the figure in the balance-sheet was far below the actual value of the property they had secured. The competition in electrical work, continued the Chairman, had been as keen as during the last few years, but to meet this their patent "C" type dynamos and motors had taken a hold of the market, and would, no doubt, be their standard type for some years to come. They attributed the increase of orders during the last year—being 50 per cent. in excess of the year before—as very largely due to the advantages offered by their "C" type over the ordinary machines offered by their competitors. The directors proposed in a few months' time to call an extraordinary meeting, and to submit a scheme for the issue of preference capital to wipe out the debentures and loans, and give working capital to take full advantage of the fifteen years in which they were protected by the patents. The company had been in existence now for thirteen years, and there were only the two years, 1905 and 1906, in which they had not shown a profit. They recommended that the £5,000 taken from the reserve fund last year be put back, that they should put another £5,000 to depreciation, £3,500 to writing down the suspense development account, and carry forward the remaining £4,500. The board regretted the death during the past year of Mr. Richard Armistead, who had been a director since the early days of the company, and to fill up the vacancy they had elected Mr. George Balfour, with whom the company had been associated in business relations since the days of its formation. They also proposed to increase the number of directors from four to five, with the object of strengthening the technical side of the board. Mr. William Armistead, one of their managers and electrical engineer, would be proposed.

Mr. J. G. UNDERHILL seconded the adoption of the report, which was unanimously carried.

Messrs. J. G. Underhill and G. Balfour were elected directors, and Mr. William Armistead was also added to the board.

Dublin and Lucan Electric Railway Co.

THE report of the directors, to be submitted to the shareholders at the fifty-second ordinary half-yearly meeting of the company on Thursday, August 22nd, shows that up to June 30th, 1907, after providing for debenture interest, there is an available balance of £1,035 8s. 5d., out of which the directors recommend the payment of the usual half-yearly dividend on the 5 per cent. preference shares, which will absorb £475; that £250 be paid to the contractors on account of the principal sum remaining due to them for electrical equipment; that £92 19s. 6d. shall be written off electric signal installation account, that amount having been paid for a new system of signalling during the past half-year; and that the balance of £217 8s. 11d. be carried forward to next half-year. It is proposed to make the dividend warrants payable on September 15th, 1907. The transfer books will be closed from the 9th to the 22nd inst.

Tyneside Tramways and Tramroads Co.

THE half-yearly meeting was held at Newcastle-on-Tyne on 6th inst. Dr. J. T. MERZ presided, and, in moving the adoption of the report, he said that the increase of traffic, as compared with the corresponding period of last year, was £693. The increase of the ordinary traffic had been £749, but the holiday traffic had not been so good as last year, owing to the unfavourable weather at Whitsuntide. The increase in the number of passengers carried was about 10 per cent., and the receipts per car-mile were 8·8d., as against 8·3d. The whole of the repairs and maintenance had been charged to revenue; and, as this was an increasing amount, the cost had been increased by £386, as compared with the corresponding half of last year. More current had been used, owing to the more frequent stops and to the service on Neptune Bank. The report showed that the reserve fund had been raised to £4,000 by taking £900 out of the revenue, and that the amount standing to expenses of registration and formation had been reduced by £330. Referring to the issue of the preference shares, Dr. Merz pointed out that of the 3,000 shares offered, 1,800 had been applied for, and that half of these had been applied for by shareholders of the company. He said that the preference shares were a well-secured investment. They bore interest at 5 per cent., and were not terminable, and, therefore, had an advantage over the debentures which ran for a number of years only.

Mr. J. H. ARMSTRONG seconded the adoption of the report. He said as the preference shares were taken up the money was being applied to wipe off liabilities in the shape of outside loans. The issue would consolidate the company's position, and put it upon a proper basis.

The report was adopted. A dividend at the rate of 2 per cent. per annum was then declared.

Metropolitan Electric Supply Co., Ltd.—The directors announce an interim dividend of 3 per cent. for the half-year. The interim dividend for the corresponding period of last year was at the rate of 8 per cent. per annum.

North-Eastern Railway Co.—The report of the directors for the past half-year, to be submitted to the general meeting to-day, contains little information bearing upon the electrified sections. The expenditure upon electric train working was £16,901, as compared with £15,894 in the corresponding half of 1906; this item consists of wages of train men, £3,852, and cost of electrical energy purchased, £13,048. The total electric train mileage was:—Passenger service, 594,479; and goods, 2,801, both showing slight increments. The electric passenger car-mileage was 1,861,415, against 1,784,844 last year.

Brompton and Kensington Electricity Supply Co., Ltd.—The directors have declared an interim dividend for the half-year to June 30th last at the rate of 9 per cent. per annum.

Charing Cross, City & West End Electricity Supply Corporation, Ltd.—The directors announce an interim dividend on the ordinary shares of the company at the rate of 5 per cent. per annum for the six months. This is at the same rate as for the same period of last year.

MARKET QUOTATIONS.

Wednesday, August 7th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	29/-	..
a ,, Oxalic	per cwt.	28/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Copper Sulphate	per ton	£32	£1 10 dec
a Lead, Nitrate	per ton	£34	..
a ,, White Sugar	per ton	£35	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a ,, Chlorate	per lb.	5½d.	½d inc.
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	230/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£9 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£200	..
b ,, Wire, in ton lots	per ton	£220	..
b ,, Sheet, in ton lots	per ton	£210	..
p Babbitt's metal ingots	per ton	£60 to £105	..
c Brass (rolled metal 7" to 12") basis	per lb.	9d.	..
c ,, Tube (brazed)	per lb.	10¼d.	¼d. inc.
c ,, ,, (solid drawn)	per lb.	9¾d.	¼d. inc.
c ,, Wire, basis	per lb.	10¼d.	¼d. dec.
c Copper Tubes (brazed)	per lb.	1/0¾	¼d. dec.
c ,, ,, (solid drawn)	per lb.	1/0¾	¼d. dec.
g Copper Bars (best selected)	per ton	£105	£7 dec.
g Copper Sheet	per ton	£105	£9 dec.
g ,, Rod	per ton	£105	£7 dec.
e ,, (Electrolytic) Bars	per ton	£96	£6 dec.
e ,, ,, Sheets	per ton	£104	£6 dec.
e ,, ,, Rod	per ton	£101	£6 dec.
e ,, ,, H.C. Wire	per lb.	1/-	¾d. dec.
f Ebonite Rod	per lb.	5/6	..
f ,, Sheet	per lb.	5/-	..
n German Silver Wire	per lb.	1/8	..
h Gutta-percha, fine	per lb.	5/6 to 6/6	..
h India-rubber, Para fine	per lb.	4/9½	1d. dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	56/-	2/6 dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£19 15 to £20	£2 5 dec.
g ,, ,, Sheet	per ton	£20 2 6	£2 5 dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£6 16 to £7	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/4½ to 1/6½	..
p ,, rolled bars & rods	per lb.	1/5½ to 1/6½	..
p ,, ,, strip & sheet	per lb.	1/6 to 1/10	..
o Platinum	per oz.	110/-	..
e Silicium Bronze Wire	per lb.	1/8½	..
Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£176 10 to £177 10	£8 10 dec.
n ,, Wire, Nos. 1 to 16	per lb.	2/3½	½d. dec.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£56 to £80	..
k Zinc, Sh's (Vieille Montagne brd.)	per ton	£28 10	15/- dec.

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Telegr. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

The Leyland and Birmingham Rubber Co., Ltd.—The report for the year ended June 30th last, states that the directors recommend a final dividend at the rate of 7½ per cent. per annum, free of income-tax, making 6¾ per cent. for the year, carrying forward £2,050. Within the last six months of the year the directors have absorbed the old-established firm of James T. Goudie & Co., of Glasgow, Edinburgh and London, and the Palatine Heel Co., Preston.

Metropolitan District Railway.—The directors recommend a dividend on the 4 per cent. guaranteed stock for the last six months at the rate of 1⅞ per cent. per annum. This compares with a dividend at the rate of 1½ per cent. for the same period last year.

STOCKS AND SHARES.

Tuesday Afternoon.

In the gloom in the Stock Exchange to which reference was made last week has to some extent lifted, it must be confessed that the holiday spirit of the time of year is playing havoc with business. The Stock Exchange markets took the usual long week-end from Friday night to Tuesday morning, and the time for reflection afforded by the Bank holiday does not seem to have been made the most of by the investor. We speak, of course, in the grossly financial sense.

Dearer money is rumoured, but with not sufficient definiteness to make it more than a cause of vague apprehension at present. The autumn rise in the Bank rate is not likely to take place for several weeks to come.

Several shares in the electricity supply list were marked *ex* dividend last week, and in the majority of cases the deductions are represented by declines in the prices. County of London Ordinary, however, have been left unchanged at 7½, *ex* their dividend of 4s., although the Preference, *ex* 6s., are ¼ lower. The Kensington and Knightsbridge distribution of 5s. has been knocked off the price, and the same amount of dividend on St. James' and Pall Mall Ordinary was reflected in a 5s. decline. Metropolitan Ordinary, *ex* 3s., are nominally ¼ down, and the 2s. 6d. dividends upon Newcastle-on-Tyne Ordinary and Preference are also shown in ¼ fall in both cases. The only real alterations are 2s. 6d. rise in South London Ordinary shares, which, at 2¼, again stand better on the week, and 5s. advance in Edmundson's Preference, which lifted the price to about 35s.

By the recurrence of further slight weakness in City and South London, the stock easing off to 46, and not a very strong market at that, some observers profess to see indications of an early new issue, the report having already mentioned the need for more capital being required shortly.

Central Londons are quiet, but the traffics since July 1st have not pointed to reinstatement of the line's more prosperous days by the introduction of the new scale of fares. Summertime has always been a bad season for the Central London since motor-omnibuses became common. Great Northern and City Preferred shares fell 5s. to 2 upon the somewhat lugubrious remarks of the chairman at the company's meeting. Districts remain at 11½. The 4 per cent. Debenture stock of the Great Northern, Piccadilly and Brompton Railway has crept up to 84 upon the appreciation by the public of the line's usefulness. Charing Cross, Euston and Hampstead 4 per cent. Debenture is more nominal at 81-84, and Bakerloo Debenture still heads the list at 90½.

Metropolitan Consolidated continues to sink even lower, and has now arrived at 41½, after being no better than a fraction over 40. The Surplus Lands stock is quoted 66.

Interest in Telegraph issues centres in the erratic fluctuations of Anglo-American Deferred, the familar Anglo "A." The price was again slumped heavily. All sorts of theories are afloat to account for the flatness, and a Stock Exchange failure last week was partially brought about by the drop in the price; naturally the failure caused the stock to be re-lowered. The two other stocks of the Anglo-American Company are quietly firm, allowing for the dividend deductions, which took place on the last Stock Exchange pay-day. Western Telegraphs gave way a trifle, and these steady-going shares can now be bought at 14, or slightly less, the return being 5 per cent. on the money at the round figure.

The two Debenture stocks of the National Telephone Company have come into some request, and are ¼ better. The other issues are all *ex* dividend. United River Plate Telephone shares, also *ex*, have been marked down to 7 middle.

Notwithstanding the announcement of their dividend, British Electric Traction Preference gave way to 7¼, although the First Debenture stock recovered a point. Maybe it is not too late to sell, for such holders, at all events, who are at all worried about an apparently bad egg and disinclined to wait for better days which may come in the nebulons hereafter. Brush Preference weakened ⅛, despite—or perhaps because of—the passage of the resolution writing down the capital of the concern. Calcutta Trams continue to show buoyancy, and at 7⅝ are another 2s. 6d. harder. The Argentine and British Columbian descriptions are stationary.

Manufacturing shares are extremely quiet. Cromptons at 2, *ex* 3s. dividend, have recovered that amount. A few other dividend markings occurred, but of no significance. Willans & Robinson Preference attracted a small amount of speculative buying, which left them at 3⅞, 2s. 6d. better on the week. Telegraph Constructions were also firmer.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations July 30th.	Closing Quotations Aug. 6th.	Business done week ended Aug. 6th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	61s.	2s%	3½%	3½%	62 — 63	61 — 64 xd	..	..	..	6 1 1
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	109 —110	107½—108½ xd	108½	107½	..	5 10 10
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	½%	1½%	18⅞ — 19	17⅞ — 17⅝	18⅝	17⅝	—1⅛	2 17 2
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	6⅞	..	— ⅛	5 12 3
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	93	92½	..	4 5 1
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	7½ — 8½	7½ — 8½	..	..	..	6 1 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15½ — 16½	15⅞ — 16½	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..	..	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101 xd	98 —101	..	..	..	4 9 1
60,710	Direct United States Cable	20	3 %	3½%	4½%	4½%	15½— 16	15½— 15⅝ xd and bonus	15½	..	..	6 15 9
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101 xd	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	134 —139	134 —139	137	135½	..	5 0 9
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	88 — 90	88 — 90	89½	..	..	3 17 9
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	104½	103	..	3 16 2
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅜ — 13⅝	13⅜ — 13⅝	13⅝	13½	..	5 2 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	104 —106	102 —104 xd	104½	102½	..	3 16 11
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —102	97½—100½ xd	..	..	..	3 19 7
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98⅜—100⅜	98⅜—100⅜	..	..	..	3 19 7
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	5½%	10½— 11½	10⅝— 11½	11	10⅝	..	5 2 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜— 14	13⅜— 14	13⅝	..	..	4 5 9
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	20 %	34 — 36	34 — 36	..	..	..	5 11 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	56 — 58	56 — 58	..	..	..	5 12 1
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	33⅓%	66 — 68	66 — 68	..	..	..	5 2 11
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	67 — 69	67 — 69	..	..	..	5 15 11
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞ — 1	⅞ — 1	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	3 %	4 %	5 %	..	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	⅞ — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	106½ 108½ xd	109⅞	106½	..	5 10 7
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½%	108 —110	105 —107 xd	106½	105	..	4 13 6
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	11½ — 13½	11 — 13 xd	..	..	..	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	9½ — 11½ xd	10⅜	10½	..	4 6 11
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅞ — 5 11/16	5⅝ — 5⅞ xd	5⅞	5 11/16	..	4 9 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	95 — 97	95⅛ — 97⅛	..	..	+ ⅛	3 1 6
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100⅛—102⅛	102	..	+ ⅛	3 18 1
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6½%	6½%	7 %	7 %	1⅜— 1⅝	1⅜— 1⅝	20/8	25/7½	..	5 1 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	24/-	..	..	4 11 5
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	91 — 94	91 — 94	..	..	..	4 5 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839†	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 10 0
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
80 000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7 — 7⅞	6⅞ — 7⅛ xd	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
15,689†	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	3 18 5
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13⅜— 14⅛	13⅜— 14	13⅝	13⅜	— ⅛	5 0 0
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅞ — 1	⅞ — 1	..	..	..	Nil
34,568	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	10 5 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	Nil
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	8 %	8 7/16— 8 11/16	8⅜— 8⅝	8½	8 7/16	—1/16	4 12 9
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	6 — 6½	6 — 6½	6½	6⅜	..	4 8 0
266,800	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 8
880,000	Babcock & Wilcox, 1 to 530,000	1	17 %	20 %	20 %	20 %	3⅞— 4⅛	3⅞— 4⅛	..	..	..	4 19 6
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜— 1⅝	1⅜— 1⅝	..	..	..	3 7 7
38,000	British Aluminium, Ord., 2,001 to 40,000 ..	5	..	7 %	7 %	7 %	4⅛— 5⅛	4⅛— 5⅛	5	..	..	7 0 0
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	5 — 5½	5 — 5½	5 1/32	5 1/16	..	6 7 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	5 — 5½	5 — 5½	..	..	..	5 9 1
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3⅞— 4⅛	3⅞— 4⅛	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101	96 — 99 xd	..	..	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	6 %	127 —132	127 —132	..	..	..	4 10 11
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	110 —114	110 —114	..	..	..	4 7 9
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	103 —106	103 —106	103½	..	..	4 14 4
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250 ..	40	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	2½ — 3	2½ — 3	55/-	..	..	Nil
161,427	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	7¼ — 7½	7 — 7⅛	7⅛	7⅛	— ⅛	8 0 0
1,448,683	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	99 —102	100 —103	100	..	+1	4 17 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	78 — 81	78 — 81	..	..	..	5 11 1
100,000	British Insulated and Helsby Cables ..	5	8 %	8 %	8 %	10 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6⅛ xd	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 5 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	87 — 91	87 — 91	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1½	1 — 1½	24/-	21/3	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	58 — 63	59 — 64	63	..	+1	6 5 0
50,000	Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	2 — 2 1/16	2 — 2 1/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	½ — ¾	½ — ¾	6/3	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	¾ — 1	¾ — 1	12/6	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	88 — 91	88 — 91	..	..	..	4 18 11
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	71 — 74	71 — 74	..	..	..	6 1 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000 ..	5	5 %	4 %	3 %	3 %	4⅛ — 4⅜	4⅛ — 4⅜	85/-	83/9	..	3 8 7
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅞ — 5⅛	4⅞ — 5⅛	96/3	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
137,610	Calcutta Trams, 1 to 137,610	5	6 %	8 %	8 %	8 %	7⅛ — 7⅜	7⅛ — 8	..	..	+ ⅛	5 0 0
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,830..	5	..	..	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 8 11
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	102 —106	102 —106	104	..	..	4 4 11
35,000	Callender's Cable Construction shares ..	5	12½%	12½%	15 %	15 %	9⅜ — 10⅛	9⅜ — 10⅛	..	..	..	6 13 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 6⅛	5⅜ — 6⅛	..	..	..	4 8 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105½—107½	105½—107½	105½	..	..	4 2 9
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	..	1/16— 1/16	1/16— 1/16	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅞ — 1 15/16	1⅞ — 1 15/16	25/6	..	..	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	95 —100 xd	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	73 — 75	73 — 75	..	..	..	5 6 8
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	94	..	..	4 5 1
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	53 — 56	53 — 56	54½	54	..	7 2 10
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1⅞%	2⅜%	46 — 48	45 — 47	47	46½	—1	4 10 5
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	6 17 11
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	93½— 96½	93½— 96½	..	..	..	5 3 8

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations July 30th.	Closing Quotations Aug. 6th.	Business done week ended Aug. 6th, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest.	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	6 3 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — ⅛	1 — 1⅛	23/9	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5⅝%	6 %	6%	6 %	13½— 14½	13½— 14½ xd	..	..	..	4 4 3
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	13 — 14	12½— 13½ xd	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	N	2½%	4½%	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	9 1 10
17,139	Do. "A" shares, 01—017,139	5	N	2½%	4½%	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85	83 — 85	..	..	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	3/16— 7/16	3/16— 7/16	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95	..	..	..	5 16 8
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	2 — 2½	1⅞ — 2⅛	..	..	— ¼	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10⅝	10¼ — 10⅝	..	..	..	6 18 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11¾— 12⅛	11¾— 12⅛	..	..	..	6 0 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5⅛	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105¼—107⅛	105¼—107⅛	107⅛	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10%	5 %	10%	10 %	15 — 16	15 — 16	..	..	..	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1⅛%	Nil	Nil	1⅜ — 2	1⅛ — 1⅜	..	..	— ¼	Nil
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	5 %	7 — 8	6¾ — 7⅞	..	..	— ⅛	6 5 0
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6¼ — 7⅛	6⅜ — 7⅛	..	..	..	8 8 7
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¼ — 7⅛	6¼ — 7⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞ — 8⅜ xd	7⅞ — 8⅜	..	..	..	5 14 3
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	84 — 88	84 — 88	85½	..	..	4 10 11
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/16— 5/16	3/16— 5/16	1/10½	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	13/16— 15/16	13/16— 15/16xd	18/-	..	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97 xd	94 — 97	..	..	..	4 10 11
30,000	Peebles (B.) & Co., 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	3¾ — 4	3¾ — 4	..	..	..	7 10 0
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	7/16— 9/16	7/16— 9/16	..	..	..	6 8 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	11/16— 13/16	11/16— 13/16	..	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	31 — 33	31 — 33 xd	31⅜	31½	..	5 9 1
150,000	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99 —102	99 —102	100¼	100	..	3 18 5
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	64 — 67	64 — 67	..	..	..	7 9
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3⅞ — 4	3⅞ — 4⅛	81/-	80/-	+ ⅛	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5⅛%	5⅛%	5⅛%	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	98 —100	100	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7⅜ — 8⅜	7⅜ — 8⅜	..	..	..	6 1 3
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	..	4 2 4
396,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅞ — 4	3⅞ — 4	77/6	75/-	..	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅜ — 4⅛	3⅜ — 4⅛	82/6	80/-	..	5 5 11
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..	6 0 0
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
49,496	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3⅛ — 4⅛	3⅛ — 4⅛	65/-	..	..	5 0 0
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 5 9
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 — 10	9 — 10	9⅛	9⅛	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10¾— 11¾	10¾— 11¾	..	..	..	5 2 2
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4½ — 5	4½ — 5	..	..	..	4 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7 — 8	7 — 8 xd	..	..	..	6 5 0
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½— 11½	10½— 11½ xd	..	..	..	5 6 8
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	½ — 1	½ — 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 2	1⅛ — 2⅛	..	..	+ ⅛	6 13 4
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5⅛%	5⅛%	5⅛%	5⅛%	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	5 8 5
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 15 8
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	96 — 99 xd	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	6 4 2
21,000	Kensington and Knightsbridge Electric Ord.	5	12%	12 %	10 %	10 %	8½ — 9⅛	8½ — 9⅛ xd	..	..	..	5 8 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 — 99	94 — 97 xd	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	5 12 3
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅞ — 5⅛	4⅝ — 5⅛	96/3	95/-	..	5 17 1
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	98 — 96	93 — 96	..	..	..	4 13 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	5⅞ — 6⅛	5⅞ — 6⅛ xd	..	..	..	6 3 1
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	4 5 9
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 4 1
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅛ — 7⅝	7⅛ — 7⅝ xd	..	..	..	6 0 9
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 — 6	4⅞ — 5⅛ xd	..	..	..	4 8 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11⅛— 12⅛	11⅛— 12⅛	11½	..	..	6 0 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6¾%	7 %	7 %	7 %	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..	5 9 11
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	8 — 9	7⅜ — 8⅜ xd	..	..	..	5 14 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6½ — 7⅛	6⅜ — 7⅛ xd	..	..	..	4 14 11
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	89	88¾	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅜ — 1⅛	⅜ — 1⅛	..	..	..	Nil
50,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	71 — 75 xd	..	..	..	5 6 8
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	1⅞ — 2⅛	2 — 2⅛	..	..	+ ⅛	6 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅝ — ¾	⅝ — ¾	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	11 2 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 3	2 — 3	..	..	..	8 6 8
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	95½	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	9 — 10	9 — 10	9½	..	..	6 0 0
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	5 — 5⅛	5 — 5⅛	5 1/16	..	..	4 1 10

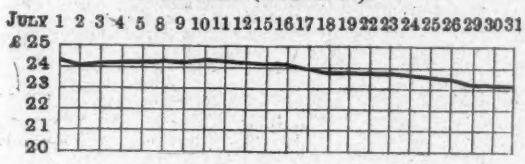
* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent., April 25th, 1907.

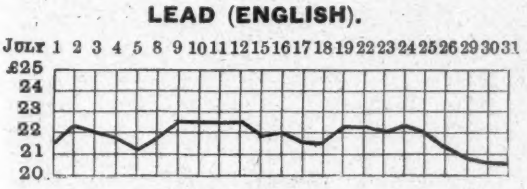
METAL MARKET.

Fluctuations in July, 1907.

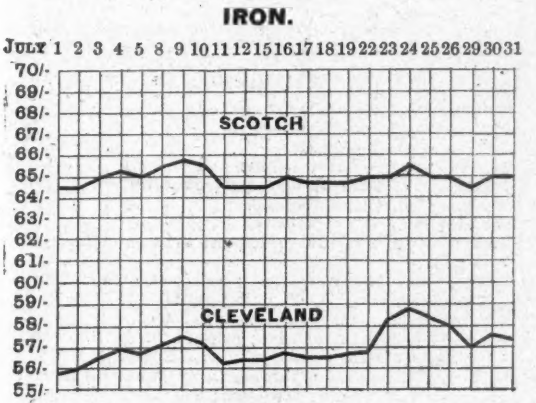
SPELTER (G.O.B's.).



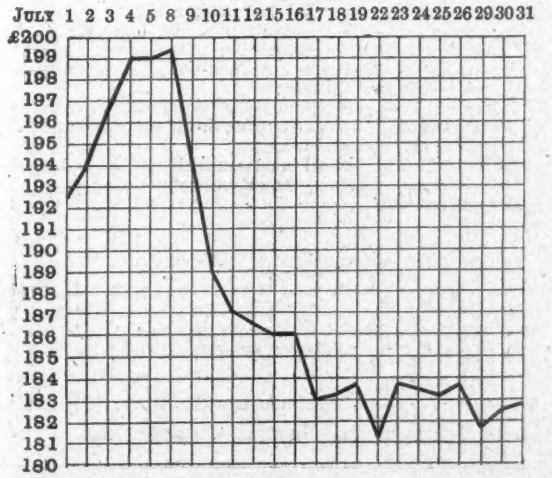
LEAD (ENGLISH).



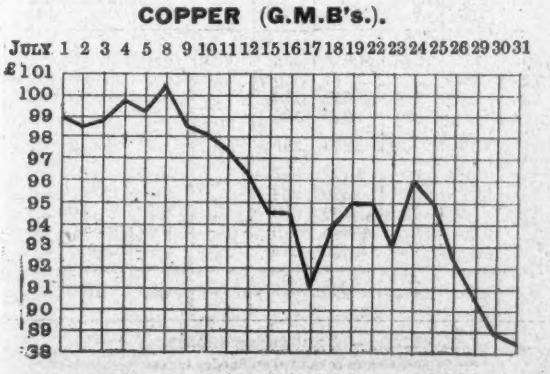
IRON.



TIN.



COPPER (G.M.B's.).



HOT-WIRE RELAY FOR SELECTIVE SIGNALLING.

By RICHARD HEILBRUN, Ph.D.

Telegraphic circuits containing a number of stations of small traffic are frequently used on the Continent, and it is of practical value, *e.g.*, for railway telegraphy, to devise means for selective signalling, or at least for enabling the stations to correspond with each other without disturbing one of them, the principal office, and for calling this principal office selectively. This is effected by means of a retardation relay placed at the principal office. The relay is traversed by the telegraphic currents common to all the stations in the circuit, but it works too slowly to be actuated by them.

Last year, when with Messrs. Siemens & Halske, the writer devised such a retardation relay. The essential part of it was simply a hot wire, all complicated parts being entirely obviated, and the instrument having thus the advantages of great simplicity and cheapness.

The experimental apparatus shown in fig. 1, p. 238, is derived from the thermometer of a Telefunken wavemeter, and the idea of it is this: A relay of any usual type has its coil included in the telegraphic circuit, and when actuated causes currents to be sent through the hot wire of my relay. The wire can be seen with its loops inside the glass vessel of fig. 1. But the ordinary signalling currents are of too short a duration appreciably to expand the air contained in the glass vessel, and in consequence the liquid rises only very little in the left limb. The quantity of the air is too large to be appreciably heated by the short currents, and the apparatus cools off too quickly to render possible the adding up of the numerous small effects to a large one. The air in the bulb expands sufficiently to make the relay respond only in case the Morse key is uninterruptedly depressed for several seconds. The responding is effected by the liquid making a contact when rising in the left limb.

The selective quality of a hot wire arrangement was first demonstrated by the behaviour of an ordinary hot-wire ammeter, and was proved by the following experiments.

By depressing a Morse key, currents varying between 43·5 and 71 milliamperes were sent through the hot wire. The displacement of the liquid was now observed by means of a scale fixed behind, first when the Morse sign of the letter v (... —) was slowly* repeated three times; and secondly, when the current traversed the wire uninterruptedly for three seconds. In order to magnify the phenomenon, slightly coloured spirit was used as a liquid of low specific gravity. The following table shows the results obtained; H_v denotes the amount in millimetres by which the liquid rose in the left limb when the three v's were given, and H_d the amount by which the flow of the steady current made it rise; $\eta = \frac{H_v}{H_d} 100$ is the retardation per cent. *i.e.*, that part of the rise produced by the flow of the steady current which is effected by the three v's. The result is the better, the smaller η, of course. The differences $D = H_d - H_v$ are those important for practical work.

No.	C.	H_v.	H_d.	η.	D.
1	43·5	1·5	5·0	30	3·5
2	46	1·5	6·0	(25)	(4·5)
3	49	2·5	6·8	37	4·3
4	55	3·5	8·5	41	5·0
5	59	3·0	10·0	30	7·0
6	62	3·0	10·5	28·5	7·5
7	65	3·5	11·0	32	7·5
8	71	6·0	12·8	47	6·8
	10^{-3} amp.	mm.	mm.	%	mm.

The values for η and D show clearly the selective or filtering effect of the hot-wire relay. In the most unfavourable case (8) the three Morse v's cause the liquid to rise only 47 per cent., or less than half as high as the steady current does. In the more favourable cases η is less than one-third. The best case is (6) with η as a minimum and D as a maximum.

For practical work the liquid must, of course, be a conductor, so mercury or an electrolyte must be used. The ratio of the specific gravities of spirit and mercury is about 1 : 17, so with mercury the difference D will only be 1/17 as high as with spirits, which in the best case would be less than 0·5 mm. It is remarkable that nevertheless mercury satisfactorily produces the selective effect, at any rate in the laboratory, especially when the proper dimensions are chosen for hot-wire, air-vessel, and tube. But the current which flows through the hot wire is derived from a local battery, so it may be comparatively large, and, as can be seen from the above table, D is practically in proportion to the current.

There is, however, nothing to prevent large differences being attained with small currents by using an electrolytic liquid, instead of mercury, *e.g.*, sulphate of copper between electrodes of copper. The deviations are then about three-quarters of those attained when using spirits. The adjustable contact seen in fig. 1 should be connected to the positive pole of the battery. The electrolytic action does not give any trouble, for a current of 13 milliamperes, which on the Continent is considered as the ordinary Morse current, may flow for five hours and not reduce the length of the copper contact by one-half of the difference D. One might also use sulphuric acid between electrodes of platinum.

* As slowly as anybody but a telegraph clerk will transmit.

A slight difficulty is presented by the influence of the surrounding temperature; but the whole apparatus could be packed into asbestos and provided with a cover similar to those used for telephone relays. It will be necessary to arrange the adjustable contact, so that it may be easily got at. No objection can reasonably be made to the necessity of adjusting it now and then, because it is a familiar fact that relays often need careful adjusting. It is also well known that the hot-wire instruments commonly used have not a fixed zero.

Fig. 2 shows the diagram of connections at the principal office, key and battery being left out. L_2 and L_1 is the line, R the ordinary

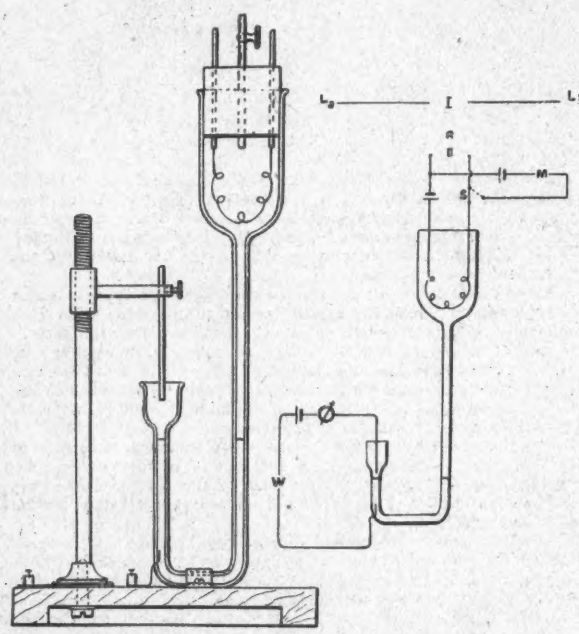


FIG. 1.

FIG. 2.

relay, I denoting its primary contacts, II the secondary ones. The latter lead to the hot-wire relay. As a rule the signalling in the circuit will not affect the hot-wire relay at the principal station. But when any of the stations depresses its key uninterruptedly for a few seconds the hot-wire relay responds and causes the bell, W, to ring. By means of the switch S, the relay is then switched off, and the Morse instrument, M, cut into the circuit. At the end of the communication with the principal station, the switch is replaced in its former position.

INDUSTRIAL GAS POWER PLANT.

[An Inquiry into the Operation, Efficiency and Construction of a Typical Modern Industrial Gas Power Plant.]

THE above is the title of a paper recently given at the New York meeting (December, 1906) of the American Society of Mechanical Engineers, by Mr. J. R. Bibbins. A condensed report appeared in our contemporary, the *Electrical Review* of New York, and as it includes a great deal of matter interesting to electrical engineers who may be considering economical power production for central stations, we have elected to extract it briefly.

After pointing out that the value of the simple producer plant for power purposes seems to have been somewhat overlooked, or at least questioned, as well as the ability of the modern gas engine to replace steam in general power work, also the capacity of a gas engine and producer to deal with widely varying loads, the author proceeds to give practical data relating to a thoroughly representative commercial gas power plant, and one in which a high measure of success has been attained. This plant is working 24 hours a day 6½ days a week, on a fluctuating manufacturing load, with a fuel consumption fully one-half that of a modern steam plant of like character and suited to the same work.

On an average of half-load this 450-KW. plant ordinarily consumes from 2 to 2½ lb. of coal per KW.-hour, and on heavier loads as low as 1½ lb. per KW.-hour in regular daily running. On occasion the plant has repeatedly developed without the battery 530 KW. on maximum fluctuation, or an overload of 8 per cent. With the exception of the charge engineers, the plant is operated by attendants not previously skilled in gas work.

This plant serves two complete works—one devoted to the manufacture of storage batteries, and the other railroad specialities—including a large steel foundry, both works being electrically driven and lighted.

There are a large number of electric labour-saving machines, such as travelling cranes, charging tables, transfer locomotives, elevators

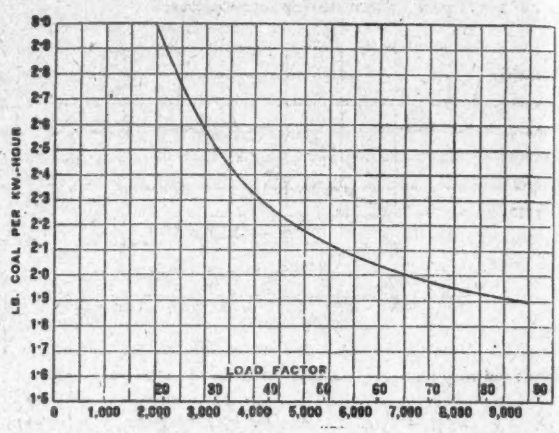


FIG. 1.—RELATION BETWEEN FUEL CONSUMPTION AND LOAD FACTOR.

conveyors, fans, pumps and machine-shop tools, and a considerable amount of current is used for "forming" battery plates.

EQUIPMENT DATA.

450-KW. producer gas power plant.
Service—Power, some lighting.
Capacity of plant—450 KW.
Number of units—Three, 150 KW. each.
Distribution system—Direct current, two-wire.
Pressure—250 volts, normal 230.
Power building—45 ft. × 61 ft.
Total area per KW.—6·1 sq. ft.; net area of unit per KW., 2·87 sq. ft.
Cooling pond—1,000,000 gallons; area (power plant), 7,300 sq. ft., (producer plant), 7,500 sq. ft.; depth, normal, 10 ft.
Gas holder—36 ft. dia.; single lift, 15,000 cb. ft.
Coal—Bituminous run of mine; price 9s. 7d. per ton; heat value, 13,500 B.TH.U.
Engines—Westinghouse three-cylinder vertical, four-cycle; capacity, 235 B.H.P., 260 max.; 200 R.P.M.; cylinders, 19 in. dia. × 22 in. stroke.
Ignition—110 volts and 8 volts; two sets 4-cells storage battery; one motor-generator set, ½ KW.
Cooling water (jackets)—Motor-driven centrifugal pumps; two 2-in. Worthington "Volute"; 15-H.P. motor.
Compressed air—100 lb. from works, also 6 in. × 6 in. Rand duplex single-stage compressor; 10-H.P. motor.
Generators—Westinghouse compound-wound, direct current.
Capacity—150 KW., 250 volts.
Producers—Loomis-Pettibone type, bituminous, duplex intermittent blast; 3 ft. to 8 ft. dia.; this is equivalent to 37 B.H.P. per sq. ft. of generator area.
Boiler—5 ft. dia., vertical tubular, utilising waste heat.
Wet scrubbers—6 ft. dia., vertical, coke, water sprays.
Dry scrubbers—Two, 9 ft. 6 in. dia., in parallel, two layers.
Exhauster—Roots' simple engine drive.
Gas main—12 in. dia.
Coal handling—Bucket elevator, motor driven.

The station load varies from time to time, with sudden fluctuations, 80 per cent. above or below the general average, and no system of notification is in force to apprise the power station in anticipation either of a fall or an increase in the demand.

OPERATING DATA.—450-KW. PRODUCER GAS PLANT, WESTINGHOUSE VERTICAL THREE-CYLINDER ENGINES, LOOMIS-PETTIBONE PRODUCERS.

Date. Sept., 1906.	Engine-hours run.	Per cent. full-day run.	Output. KW.-hours.	Aver. load KW.	Rated load KW.	Station load factor.*	Fuel used.	Coal per KW.-hour.	Coal per B.H.P.-hour.
20	71	98⅔	4,850	202	450	45	11,100	2·29	—
21	65½	91	5,275	220	,,	49	11,400	2·16	—
22	70	97¼	6,550	273	,,	61	12,700	1·93	—
23	45¾	63½	4,025	188	,,	41·7	8,800	2·18	—
24	24	33⅓	2,250	187·5	,,	41·6	†6,600	†2·93	—
Sunday									
25	70½	98	6,400	267	,,	59	12,000	1·87	—
26	69¾	97	6,300	263	,,	58	12,300	1·95	—
27	70½	98	6,700	279	,,	62	12,600	1·88	—
28	72	100	6,700	279	,,	62	12,900	1·92	—
29	70½	98	6,600	275	,,	61	12,900	1·95	—
Av'r'ge	63	87¼	5,565	243·4	450	54	11,330	2·04	1·44

* Load factor = % continuous generating capacity.

† Includes extra coke used on Sunday for starting new fires.

With coal of 13,500 B.TH.U. thermal value, the efficiency of this plant averages about 13·1 per cent., thus rivalling, if not excelling, that of the largest modern steam power stations.

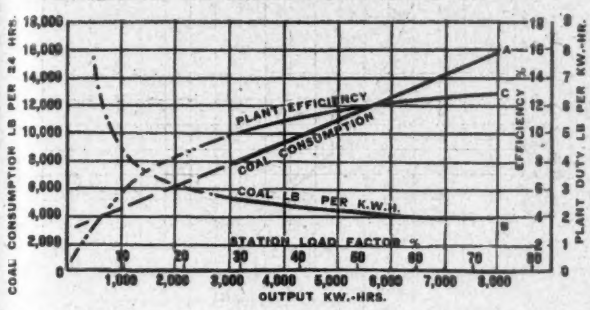


Fig. 2.—Average Plant Duty with Various Load Factors.
Observed results ————; estimated results — · · — · ·.

With a load factor of 62 per cent. the fuel consumption was 1·88 lb. per KW.-hour, or about 1¼ lb. per B.H.P.-hour, giving a plant efficiency of over 15 per cent.

From observed data a diagram, fig. 1, has been prepared to show the relation between the fuel consumption and the load factor for this plant.

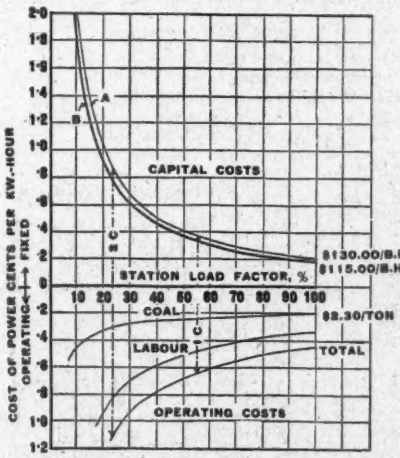


Fig. 3.—Relative Power Costs with Various Load Factors.

From further data a diagram, fig. 2, has been prepared, giving the average duty under various load factors.

The curve C shows the kinetic or absolute efficiency of the station, as

$$= \frac{\text{Thermal equivalent of work done}}{\text{Heat in coal}},$$

and it is of interest to find that this small plant normally works with an efficiency* between 12 and 13 per cent. on the average.

---

* Since the above observations were made the plant has been giving much better efficiency, the coal consumption averaging 1·8 lb. per KW.-hour with an 85 per cent. load factor. This corresponds to a plant efficiency of over 15·4 per cent. at the engine shaft, or 14 per cent. at the switchboard. Several runs averaging 1·55 lb. per KW.-hour are recorded, equivalent to a plant efficiency of 17·7 per cent. at the shaft, or 16·3 per cent. at the switchboard. As the efficiency of the producer is an important point for comparison, this can be found from the observed data:—With a load factor of 50 per cent. the average plant efficiency is 12 per cent., the engines 17 per cent., and the producer slightly over 70 per cent. At 75 per cent. load, the plant rises to 13 per cent.; engines 20 per cent.; while on an especially good day's run the efficiencies were as follows:—Plant, 15 per cent.; engines, 25 per cent.; producers, 71·5 per cent. Coming to the question of cost, the following table has been prepared for a range of outputs and coal costing 9s. 7d. per ton.

Approximate Power Costs.

	Minimum.	Normal.	Maximum.
Output, KW.-hours per day ...	5,000	8,000	10,000
Fuel, cost per KW.-hour	·125d.	·110d.	·100d.
Labour „ „	·140d.	·085d.	·070d.
*Supplies and repairs per KW.-hour	·085d.	·065d.	·055d.
Operating costs per KW.-hour ...	·350d.	·260d.	·225d.
Fixed charges „ „ ...	·225d.	·140d.	·110d.
Total costs „ „ ...	·575d.	·400d.	·335d.

*Estimated, assuming 25 per cent. of total power costs at 50 per cent. load-factor, hence the estimate is conservative. The capital cost is given as £19,034.

To show the relation between the station load factor and the capital and operating costs, fig. 3 has been prepared, the former plotted above, and the latter below, the axis.

The total cost of power is given by the total ordinate. While the cost of coal remains fairly constant, the costs for fixed charges and labour increase rapidly on light loads, and supplies and repairs less rapidly. It will be observed that the total cost is halved by increasing the load-factor from 24 to 55 per cent. Taking into consideration the small size of the plant, the results obtained in the Depew installation are a striking object lesson, and should be of service to engineers dealing with similar problems.

IMPROVEMENTS ON THE CHICAGO TRAMWAYS.

Now that the great struggle against municipalism has ended in victory for private enterprise regulated for the good of the community, Chicago looks forward to a renovated tramway system, and the two companies which control the franchises have accepted certain ordinances in which the general nature and method of the improvements are specified.

All new rails are to be of the American grooved type, in which the splayed lip reveals the ascent from the older step rail. This rail is to weigh not less than 129 lb. per yard, and the section given in the *Electric Railway Review* for April 6th shows it as 9 in. high, having a base 6 in. wide, a web all but 6 in. high in the clear, by ½ in. thick, the total width of the head being 5¼ in., of which the tread is 2⅜ in., the groove 1⅝ in., and the table of the lip ⅜ in., while the lip is depressed ¼ in. below the tread.

That constitutes practically the new standard tramrail of America, and the design supplies evidence of mutual accommodation between the interests of the users of flanged wheels and the users of flat wheels, which is not so obvious in the standard British tramrail.

Rail joints are to be welded or of an equal quality, and however made, must have the same conductivity as the rail itself. Bonds are required, except when joints are welded, and we take this exception as the best possible evidence of the growth of faith in the permanence of welded joints. Had the ordinances been drafted a few years ago, the use of an auxiliary copper bond across each weld might have been required.

The greatest latitude is to be allowed in the construction of the permanent way, the rails being laid upon concrete beams, wooden or steel sleepers, or cast-iron chairs, or in some other form of first-class, modern construction; and the foundation is to be either of concrete, crushed stone, or other ballast material, which best suits the conditions of soil and drainage. A board of supervising engineers will decide in this and in all other engineering matters what is suitable. It is difficult to say whether the toleration of any decent kind of sub-structure is likely to lead to confusion in future, but we incline to the belief that, so long as the rail section is not altered in the same way, variation of the support carries no practical disadvantages, and as we have seen, the rail has been definitely standardised.

The wearing faces of points and crossings are to be made of hardened steel, this regulation leaving the impression that manganese steel inserts have given better results in the U.S.A. than in England, where we have not yet come to the conclusion that there is any great advantage to be gained by allowing for the renewal of a small part of points and crossings.

Trolley wire poles are to be of iron or steel, weighing about 900 lb. each, and spaced from 100 to 115 ft. apart on straight track. As the trolley wire is to be not less than 2/0 B. & S. gauge the pole weight does not reach the British standard, which is not necessarily right, and only one size is specified, this evidently being considered heavy enough (as we ourselves consider it) for all but extreme cases of curve or anchor stresses. At the same time allowance must be made for the possibility of the poles being somewhat shorter than the British pole, although this is not at all certain.

Poles are to be set in concrete, and kept thoroughly painted, and there is no suggestion that money shall be wasted on exaggerating the ugliness of a necessity by loading the poles with scroll work and cast-iron bases.

No longer are the central portions of Chicago to be made hideous with overhead feeders, and powers are reserved to force the companies to place all wires, except trolley wires, underground in any part of the city limits whenever it is decided to order all other public service wires to be buried also. In any case transmission wires carrying a pressure of 1,000 volts or more are to be placed underground.

In order to reduce the number of poles in the streets, permission is given to attach cables and wires to overhead railway structures by consent of the railway companies, and the city electrician is given supervisory powers.

The tramway companies have to maintain, *sweep, sprinkle and clean* the portion of the roadway occupied by their lines, including the removal of snow, a regulation with which we have little sympathy. With a grooved rail, or with a step rail having a wide step, and a fairly paved track, the tramway companies in America have had no greater monopoly of the portion of the roadway in which their rails happen to be laid than they have in England, and it is unfair that in either country they should have to bear the whole cost of maintaining a roadway, which would not have been so

good and solid without them, besides paying in rates for the maintenance of the remainder of the road and footpaths; while there is even less ground for burdening a public service with cleansing a road which it has had no hand in fouling. Even in the days of horse-drawn trams the companies should have been no more and no less liable to remove refuse, and, finally, to sweep the streets than the hackney cabman or any other horse owner.

The conditions forced upon the companies with regard to paving are as onerous, and even more so, than the corresponding English conditions, but a first-class standard of paving is adopted, and Chicago soon ought to be as proud of its streets as Glasgow or any large English town. So long as the existing paving is serviceable and reparable, or until the road outside the tracks is repaved, or, again, until the company has to relay the rails, the paving is to be permitted to remain; but when the time comes the tracks must be repaved with dressed granite blocks "having an uniform grain and texture, without lamination, and free from excess of mica. These blocks shall measure 3½ in. to 5½ in. in width, from 7 in. to 11 in. in length, and are not to be less than 5 in. deep." The joints shall average ¼ in., being not less than ⅛ in., not more than ⅜ in., and all longitudinal joints shall be broken by a 3 in. lap. The spaces between the blocks are to be dry grouted with clean gravel to within 2 in. of the surface, and the blocks rammed with a 75 lb. rammer. Then the joints shall be sealed to the top with a specified quality of coal-tar pitch, run in at a temperature not below 280° F., and in quantity not less than 2 gallons per sq. yd.

All new lines are to be paved in that manner, and wherever a double track is to be laid, or is to replace a single track, and the street is not at least 38 ft. wide, the companies have to widen it at their own expense (including the purchase of private property), and must pave up to a width of 8 ft. more than the space occupied by their own tracks.

We have given special prominence to these P. W. regulations, because they show how nearly the American cities are coming into line with European cities in the matter of substantial construction. The movement has been spreading steadily during the past five years.

Into what a dilapidated condition the Chicago tramways have been forced by the Damoclean system of Mayor Dunne and his predecessors, may be gathered from the passage of the ordinances, which lays down that at least 375 new cars must be put into operation within one year. The type of car is specified as follows: —They are to have centre aisles, no running boards (so useful for overcrowding), and heavy motors. Reversible cross seats are to be used, with the option of putting longitudinal seats at the ends, each holding not more than four passengers.

All closed cars are to be vestibuled, including those already in service, and all new cars are to seat 40 to 50 people. Naturally, they are to be single-deckers on double trucks.

After one year trailers are not to be used, and two motor-cars must not be coupled. It is curious to note that at the very time when this prohibition is issued in Chicago the use of trailers is said to be spreading in Germany.

The reformation of the Chicago tramways involves ripping up and relaying on the overhead system 82 miles of cable track, the reconstruction of 150 miles of electric track, the building of 2,000 new cars, and the probable building of new power houses.

Who can estimate the grumbling which preceded this convulsion?

Electrolysis of Gold Solutions.—A description has recently been published by Mr. D. Lay of the method employed for electrolysing cyanide solutions containing gold at the Reliance Mill in Nelson, British Columbia, where 150 tons of liquor have to be treated every 24 hours. The liquor itself is a 0·01 per cent. solution of potassium cyanide. It is treated in three vats each about 34 ft. long by 5 ft. wide by 3 ft. deep. The anodes are composed of plates of iron a little more than 5 ft. long by 2 ft. 6 in. wide held at distances of 3 in. apart in grooves in the walls of the bath. These anodes are carried in such positions that every alternate one reaches to the bottom of the vessel, while the others stand about 2 in higher, so that the liquid is compelled to flow upwards and downwards over the top of each second anode. The cathodes are composed of sheet lead about the same size as the anodes. Current is employed at a voltage of from 4 to 5, and a density of from 0·02 to 0·03 ampere per sq. ft. Such low current densities cause the gold and silver to be deposited in a coherent form. According to the author's experiments about 30 per cent. of the free potassium cyanide in the liquor is decomposed as it passes through the bath, but this decomposition can be almost entirely avoided by rendering the solution faintly alkaline (0·03 per cent.). When the solution is alkaline the formation of Prussian blue is also greatly diminished. The noble metals are almost wholly precipitated in the baths. Mr. Lay quotes the following formula for the size of the cathodes to be employed:— $K = 1{,}750\ B$, where K is the superficial area in sq. ft. and B is the amount of liquor to be treated in tons.

Chlorine Acne.—In the course of an article published in the German journals on the maladies to which men working in chemical factories are subject, Herr Leymann, of Wiesbaden, makes some reference to the skin disease known as chlorine acne. The author does not believe the acne to be caused by the action of pure chlorine, but regards it as arising from certain chlorine compounds which are produced in electrolytic cells from the tars employed in constructing the vats.

THE CRAMP SINGLE-PHASE MOTOR.

By W. CRAMP.

THE tests upon the above machine, promised many weeks ago, have now been completed, and the more important of them are given below. They appear to bear out well the theory of the motor given in the *Jnl. I.E.E.* (Vol. 38, p. 548 *et seq.*), and to justify the diagram given in the same paper. It is hardly necessary here to repeat this theory, which has been given fairly completely in three different forms*; but the

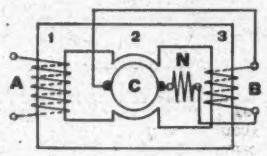


FIG. 1.

main contentions may with advantage be recapitulated, and a diagram of the machine will serve as a reminder of the principles involved.

In this diagram (fig. 1) A and B are the two limbs of the motor, C the armature. On the limb A is wound a coil connected to the supply mains. By transformer action the coil on the limb B supplies current to the armature C, which may or may not have a neutralising coil N in series with it.

The main contentions then are:—

1. That such a motor has characteristics of speed, torque, current, voltage, very similar to those of a series motor.

2. That with constant terminal voltage, the primary current may be expressed by a circle diagram very similar to that of the induction motor.

3. That as the speed rises the power-factor will rise, and there is no reason why the machine should not have, at full load, a power-factor as good as an induction motor.

Other contentions as to commutation and efficiency were also set forth, and these are referred to later.

The tests, from which the following curves are drawn, were carried out at the Manchester School of Technology by Mr. Garner and Mr. Browning, with occasional help from other groups of students.

A view of the actual machine tested is given in fig. 2.

Every instrument used in the test had its calibration checked carefully, and all readings taken were properly corrected so as to avoid any possibility of error. On every

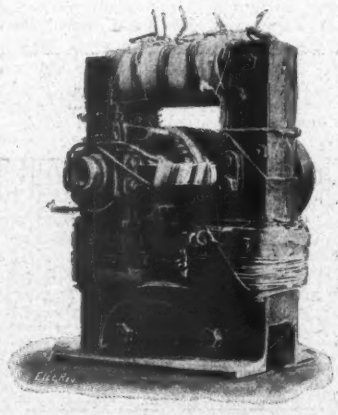


FIG. 2.

curve are shown the points from which it was actually drawn. In order to make the comparison between this machine and the corresponding series motor more complete, arrangements were made so that the limb B, fig. 1, could be removed, and the armature terminals connected in series with the limb A. Fig. 3, curve 1, shows the open-circuit or

* See paper above referred to; also ELECTRICAL REVIEW, May 11th, 1906, and February 22nd, 1907.

magnetisation characteristic with limb B in position, and the armature circuit open. Fig. 4 shows the short-circuit curves for the machine with and without limb B. The open-circuit curve shows clearly that saturation sets in when the magnetising current is about 6 amperes, while the two short-circuit curves of fig. 4 show how little the upper limb changes the reactance of the machine.

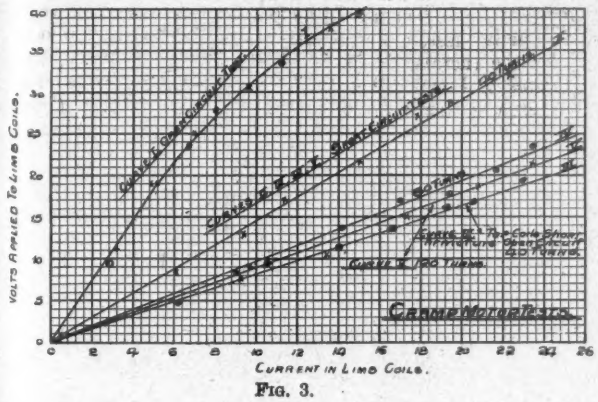


Fig. 3.

The voltage chosen for running the constant-voltage tests was such as to give, in each case, about the same armature current under similar conditions of speed.

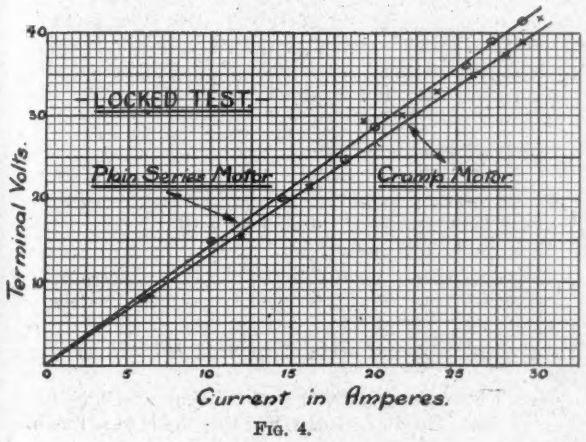


Fig. 4.

It should be added that the motor was direct coupled to a small continuous-current generator, by which means the load could be accurately read, and a loss curve of this machine enabled the *total* load on the motor to be obtained.

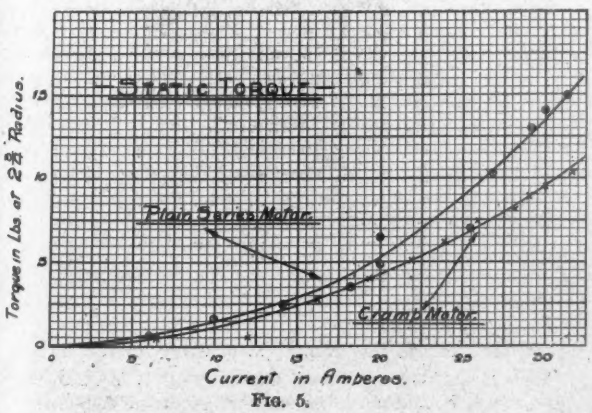


Fig. 5.

From the two sets of curves, figs. 3 and 4, the circle diagrams corresponding to the two cases can be set out as described in the papers referred to above: the load characteristics can then be deduced therefrom, and compared with the tests at constant voltage. This comparison is carried out below.

With regard to neutralisation, tests were made with and without a short-circuited coil (passing through slots in the pole faces and surrounding the armature), but practically no change in the armature impedance resulted, for it must be remembered that the full transformer ampere-turns are acting across the air-gap, and in consequence a fairly long air-gap and a short pole arc could be used; both of these tend toward small armature impedance.

Fig. 5 shows a static torque test of the motor. It will be seen that with low currents the plain series motor has, as might be expected, slightly higher torque for the same

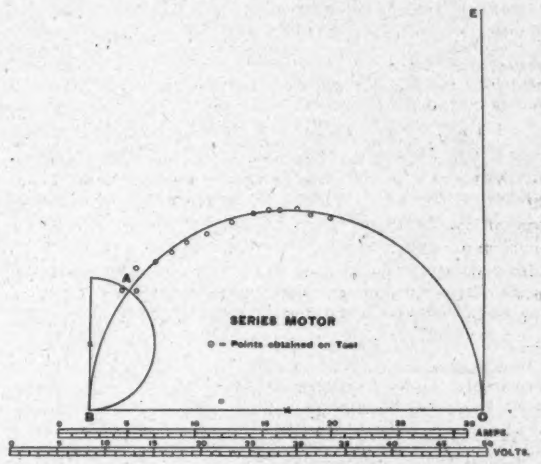


Fig. 6.

stator current; and with the heavier currents the effect of the reactance of the secondary coil, in straightening out the curve, is clearly shown. This effect is due chiefly to saturation in the limb B, and could easily be avoided in any given case. It is obvious that contention 1, given above, is borne out by these tests.

In fig. 6 the circle diagram for the series motor is set out from the short-circuit current readings as explained in the paper. The load readings, as taken from the motor actually on test, have been plotted and are marked by points upon the same diagram—O A being the short-circuit current. It will be seen that the theoretical circle and the actual test agree fairly well.

In fig. 7 the circle diagram for the Cramp motor is shown —O A is the no-load and O B the short-circuit current. In

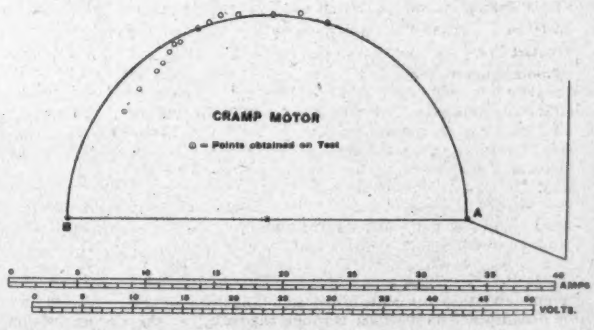


Fig. 7.

obtaining this latter, the current O B was set out as though the machine reactance were constant, *i.e.*, saturation, which is clearly existing, as shown by figs. 3 and 5, was not allowed for. This accounts for the fact that the load readings fall well on the circle for the smaller currents, but fall inside the circle on the higher currents. It will be noticed that the points begin to leave the circle just at the place where saturation sets in, *i.e.*, figs. 5 and 7 agree absolutely. It so happens in this case that on account of the proportioning of the various limbs, saturation occurs first in the limb B

(fig. 1), resulting in rather large secondary useless leakage on high currents. It is this leakage which accounts for both the falling away of the torque curve and the fact that the points fall inside the circle diagram on the higher loads.

The diagrams, however, certainly justify the use of the construction as set forth in the Manchester paper, and prove contentions 2 and 3, p. 240. Reference to this diagram will show that the maximum power factor obtainable is 80 per cent.; this maximum was never reached in actual test on account of the high speed which corresponded to the high power factor. The high speed is chiefly due to the fact that the machine was bipolar.

The effect of the number of turns of the secondary coil is of some importance. Fig. 3 shows a series of short-circuit tests taken with different numbers of secondary turns, the primary turns remaining constant. It is needless to add that the greater the short-circuit current for a given applied voltage the better is the maximum power factor obtainable. The value of the short-circuit current for a given voltage depends not only upon the number of secondary turns, but also on the number of armature turns, which should be as few as is consistent with a reasonable commutator current.

It will be noticed that increase of the number of secondary turns does not result in a proportional increase of short-circuit current; the reason for this is that the self-induction of the secondary increases as the square of the number of turns, so that a limit is reached beyond which the short-circuit current would actually fall with further increase in the number of turns. This limit is in the present case reached at about 150 turns. The number of secondary turns is dependent upon the number of armature turns used. In the present instance this was much higher than is necessary for the motor as a rule. A large number of turns was employed for this machine in order to enable it to be used as a series motor for comparative tests; but as one of the chief advantages claimed for it is low armature self-induction and good commutation because of the few turns required, it will be seen that the provision of a large number of turns for the sake of the series motor, was very detrimental to a fair test of the machine as a Cramp motor.

The comparison of the latter with other types of single-phase commutator motor, as carried out in the Manchester paper, has been criticised rather severely. It should be recognised that three general forms of the machine are possible as indicated in figs. 1, 8 and 9. Of these three,

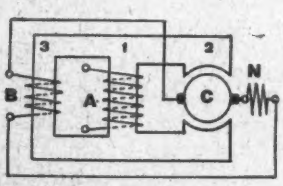


Fig. 8.

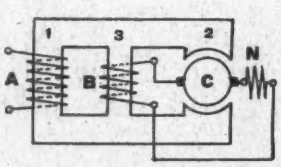


Fig. 9.

fig. 8 is probably the best, its advantage over fig. 1 lying in the fact that the iron between limbs 1 and 2 does not have to carry the flux due to limb 3; so that this form will work out lighter and more compact than fig. 1. The latter, however, lends itself well for a multipolar design, an example of which is shown in fig. 10, where the letters A and B refer to coils having like functions to those similarly lettered in fig. 1. When the coils A are connected to the mains and the coils B are on open circuit, the yoke ring acts exactly as a transformer core. When coils B are closed upon the armature, they act as transformer secondaries, thus providing the armature current and setting up a leakage field through the field poles. Usually coils A would consist of more turns than coils B, the latter producing only the low voltage required for an armature of very few turns; even an armature equivalent to one bar might be used. If the ring form were adopted as shown in the figure, it would be convenient to have the stampings divided so that coils A could be slipped on after winding. Coils B, consisting usually of few turns only, could be wound in place. The multipolar form of the machine is of importance, as only in the case of low frequencies and high speeds could a fair power factor be obtained with two poles; multipolar forms other than that shown are, of course, possible.

Now in a comparison between such a machine and a series motor it will be seen that the differences existing are mainly these:—

1. Armature turns required for given terminal P.D.
2. Section of yoke ring required.

In (1) the comparison is to the disadvantage of the series motor. In (2) it is to its advantage. Calculations lead to the conclusion that increasing the weight of the yoke of a standard series motor from 50 per cent. to 100 per cent. will, as a rule, make sufficient allowance for the increased flux required above that needed for the simple series motor; and by similar reasoning the figure which was previously given for the increase in weight of copper was arrived at. An example will make this more clear. A 50-H.P. plain series alternating-current motor for 30 cycles per second can

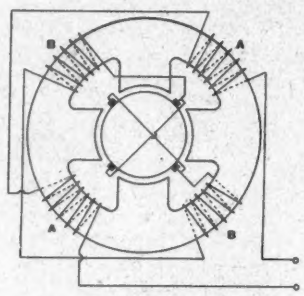


Fig. 10.

be designed easily to run at about 500 R.P.M. on a 100-volt circuit. Such a motor will need about eight poles, and with the densities that are being at present used, the armature diameter will be about 22 in., and its length between end plates about 8 in. The weights of net effective material for such a machine will be about as follows:—

Armature iron	400 lb.
Stator iron	700 lb.
Armature copper	180 lb.
Field copper	120 lb.
Commutator copper	300 lb.

These values give:—

Net effective iron	1,100 lb.
Net effective copper	600 lb.

Such a machine will have a yoke section of about 26 sq. in., and the length of mean turn of the field coils will be about 30 in.

In order to use this motor upon ordinary supply circuits, a transformer will be necessary, and this would have roughly the following weights:—

Net effective iron	900 lb.
Net effective copper	400 lb.

Now, if the stator of the above machine be re-arranged to work as a Cramp motor on the lines of fig. 10, it will be necessary to increase the yoke section if a corresponding number of field-turns is to be retained.

The amount of increase necessary depends upon the density at which the yoke was originally worked, and also upon the density at which the yoke may be worked when it is used as a simple transformer, *i.e.*, with the motor doing no work. In this particular instance, allowing for a maximum density not exceeding that which will give a reasonable magnetising current, the yoke section will have to be almost doubled. This gives us the following table of weights:—

Armature iron	400 lb.
Stator iron	1,300 lb.
Armature copper	180 lb.
Field copper (primary and secondary)	320 lb.
Commutator copper	300 lb.

These values give:—

Total net effective iron	1,700 lb.
Total net effective copper	800 lb.

This is entirely apart from any question of neutralising coils, and it is, moreover, the most unfavourable comparison so far as the Cramp motor is concerned, as the armature and commutator have not been redesigned, nor have the magnetic densities been re-arranged, which should be done if the best effect is to be obtained. This results in the ratio of iron weights coming out greater than was originally given, while

the copper increase comes out smaller. As a matter of fact, the figure originally given for the increase of iron required was almost certainly on the small side, and this figure was corrected for reprinting in the Institution Journal. The table below gives in a succinct form the results of the above calculations :—

	Series motor, simple.	Series motor with transformer.	Cramp motor.
Suitable to voltage ...	Low only	Any	Any
Iron weight, total ...	1	1·8	1·55
Copper weight, total ...	1	1·66	1·3

It would thus seem that the method of using the combined motor and transformer, instead of the two separate pieces of apparatus, results in a considerable saving, at any rate, in copper. Indeed, the saving which takes place is closely allied to that which exists in an auto-transformer, as compared with an ordinary transformer.

It should be remarked that the length of mean turn of the field coils in the two cases is practically the same.

With regard to power factor, it is clear that the only condition for success for the combination is that there shall only be a moderate fraction of full-load current when the full voltage is on the coils A, and the armature is open-circuited. In an induction motor of this power a no-load current of one quarter the full-load current would not be unreasonable. In the case given above, the no-load current works out considerably less than this, *i.e.*, it is more nearly one-eighth of the full-load current. Such a fraction will only slightly decrease the power factor, and by rearrangement of the armature winding even this decrease might be obviated.

As has been mentioned, the tests above given have been carried out at the Manchester Municipal School of Technology, and the writer's thanks are due to the Principal and Committee of the Institution, to Prof. Schwartz, head of the electrical department, and to the students above-mentioned, especially Mr. Garner.

REVIEWS.

Analysis of British Coals and Coke. Compiled by Allan Greenwell, F.G.S., and J. V. Elsden, F.G.S. London : The Chichester Press. 1907. Price 5s. net.

This really cheap and valuable book is an attempt to collect the characteristics of the chief British coal seams, together with the chemical analyses of the coals and many of the cokes. The authors regret that the analyses present have not been made from test samples collected by some standard method.

Some firms have recognised that coals should be analysed in two ways—(1) from a genuine sample, including all ash-making matter, and (2) from a picked sample, whence is to be sought the analysis of the true combustible or pure coal. But no one can credit an analysis as a bulk analysis which shows only 0·6 per cent. of ash. Such a sample must have been a picked lump.

The volume commences with a chapter, by Mr. Clarence A. Seyler, B.Sc., on the classification of coal, and interpretation of analysis and methods of analysis.

Regnault made the first ultimate analysis of coal. His and Gruner's classifications give six classes—anthracite, sean or anthracitic ; short-flame bituminous ; true bituminous ; long-flame bituminous ; dry long-flame coal, and lignite. People generally are very apt to think that there is a great deal of hydrogen in bituminous coal. This is far from the case. Coal with more than 5·8 per cent. of hydrogen becomes almost or quite cannel. A very little hydrogen will produce a great change in carbon. Pitch, plastic as it is, is so rendered by the effect of only perhaps 1 per cent. of hydrogen.

Mr. Seyler endeavours to form a fresh classification on the basis of percentage of total carbon and percentage of hydrogen.

The scheme of the book assumes four great divisions, viz., the Scotch coalfields, England and North Wales, South Wales, and Ireland, and the various seams of each set of coalfields are described, with the characteristics of their products generally. Thus, from the Lancashire field we find the Wigan 4-ft., 5-ft. and 6-ft. seams, the Arley, the Orrell 5-ft., the Mountain mine, Pemberton, and so on, while the same seam in different pits is also described, for a given seam of coal does not carry the same characteristics right through the field.

Many of the coals are described in terms of their yield of gas, tar, ammoniacal liquor, coke, &c. The appearance of the coal is also given, *i.e.*, its mineralogical characters.

In one coal from this county, the Crombanke seam, no less than 41 per cent. is volatile hydrocarbon, such is the power of a small quantity of hydrogen to render carbon volatile at quite a low temperature. It is, of course, this volatility, and the conversion of so much heat of the fire into latent form, that renders necessary special furnace design for bituminous coals. In Lancashire coals of the gas variety, even 52 per cent. will be volatile. Yet this volatile matter does not result in any very special volume of gas on distillation, less, in fact, than coals of much less degree of volatility, showing that the volatile carbon, as shown on analysis, does not go off as hydrocarbon gas in the retort. The coals of Yorkshire much resemble those of Lancashire in their general characteristics. In Welsh "Navigation" there is a trifle over 4 per cent. of hydrogen, and there is less than 5 per cent. in Long Rishton Lower Mountain mine coal in Lancashire, so that here again the effect of hydrogen differences is very great for a small difference. Even in Little Vein anthracite there is 3·54 per cent. of hydrogen.

In a so-called smokeless Welsh from Cwmammon, there is, however, less than 12 per cent. of volatile matter, but there is close upon 4 per cent. of hydrogen, so that again volatility is seen to be not so much a question of quantity of hydrogen, as of the manner of its union with the carbon.

Only one Irish coal appears among the analyses, namely, the Arigna, from Co. Roscommon, an excellent coal, low in sulphur.

The American Government has recently, through the agency of the Geological Department, conducted a valuable series of coal tests on coal from all over the Union, with a view to ascertaining how best the different coals should be treated, and the book before us contains in condensed form much of the sort of information which in the American reports appears *in extenso*. It winds up with the section on cokes, some of which appear to carry some 90 per cent. of carbon, but some of the Derby cokes run up to nearly 94 per cent., as also some Durham cokes, one of which we find as high as 94·4. The Lancashire Mountain Mine seam gives a coke of 94·28 per cent. of carbon, and 0·45 sulphur. The Scotch cokes are very high in carbon ; one of them stands actually 96·68, and only 0·36 per cent. of sulphur.

Altogether this is a most useful work that steam engineers should possess, so as to be able to pick suitable fuel in their particular part of the country. The book requires extension, of course, for we find no reference to the 12-yd. seam, or Dudley thick coal, nor do we find Haigh Moor indexed, that excellent Yorkshire seam which, we believe, is one of the best steam coals of the country, though it appears indirectly.

The Testing of Alternating-Current Machines in Laboratories and Test Rooms. Vol. I. C. Kinzbrunner, A.M.I.E.E. London : Harper & Brothers. 1907. Price 4s. 6d. net.

On the title page this book is described as a "practical work for students and engineers," and in the preface we are told that it follows the general scheme of the author's book on "The Testing of Continuous-Current Machines." In this volume general measurements and instruments, transformers and alternators are considered. Owing to the large field the author has to cover, he has only space for very meagre descriptions of some of the instruments shown, and so a great deal has to be left to the intelligence and general knowledge of the reader. The book gives us the impression of having been written in a hurry, and we think that the author could have considerably improved it with very little trouble.

In Chapter I the author makes general remarks on testing. On page 3 we are told that "the percentage accuracy of the readings of the various instruments employed in one experi-

ment should be the same. For instance, it is useless, in measuring resistances, to read the value of the current accurately to 0·1 per cent. if the voltage is measured with an accuracy of 1 per cent. only." Personally, we feel happier when we know that the maximum possible error in our measurement is 1·1 per cent. than when it might be 2 per cent. On page 4 we come to descriptions of various "starters" for squirrel-cage rotors. On page 6 we have a theory of Niethammer's arrangement of starting resistances, but there seems to be something wrong with the formula at the top of page 7. We cannot see where the 1·2 comes from.

Like many other writers, the author makes no distinction between "angle of displacement" and "phase difference." The proof of the three-voltmeter formula given on page 52 is not rigorous, and the comments on it are not intelligible. "Obviously, the method will give reliable results only if the angle ϕ is sufficiently large, or, in other words, if the resistance R can be made large enough" (page 52); R is the non-inductive resistance, and cos ϕ is the power factor. Surely ϕ is independent of the value R, otherwise the method is of no value.

On page 54, in a description of an ordinary electro-magnetic wattmeter, we read:—"Since, as we know, the product or (of ?) instantaneous voltage by instantaneous current is really equal to the instantaneous power, the wattmeter will at any moment indicate in a direct manner the watts supplied by an alternating-current circuit." This gives the impression that the wattmeter records the instantaneous watts, and not the average watts. A great deal is given about the measurement of power in polyphase circuits, both theoretical and practical. The method described in fig. 74 is not correct. When the ampere-coil is in one main, and the volt-coil is connected between that main and an adjacent one, the total power on a balanced load is not equal to $\sqrt{3}$ times the reading (page 62).

On page 103 the methods of finding the ratio of a transformer are discussed. We are told that the use of two voltmeters of different ranges for making the measurements, makes the test "rather unreliable." We much prefer this method, however, to the method described of finding it by boosting the voltage and using only one voltmeter. The possible percentage error in the result due to the unavoidable errors of observation is very much larger when we have to measure the difference between two readings nearly equal to one another than when we have to find the ratio of two readings.

The method given by the author (page 84) for separating the hysteresis and eddy current losses is of very little use. Even granting that the eddy current loss varies as the square of the frequency, the formulæ (37) and (38) giving the respective coefficients show that a very small error made in measuring any of the four variables makes a large error in the values of the coefficients. It would be instructive to point this out to the student.

We have noticed several misprints—c_2 for c_1 in fig. 81; Duddel for Duddell in figs. 93 and 94; page 117, line 12, v_3 for $\sqrt{3}$, &c.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

16,705. "Improvements in high-tension distributors for use in connection with the electric ignition systems of internal combustion engines." The Electric Ignition Co., Ltd., and F. H. Hall. July 22nd.

16,710. "Improvements in dynamo-electric machines." Bruce Peebles and Co., Ltd., and J. L. la Cour. July 22nd.

16,731. "Improvements in and relating to conduits, particularly conduits for electric tramways." W. Manders. July 22nd.

16,735. "Improvements in or relating to the electrolytic or chemical deposition of metals, or for making metallic articles by electro-chemical deposition and apparatus therefor." H. C. Harrison. July 22nd.

16,736. "Improved method of melting or fusing glass or like vitreous material around and on to electric conductors." C. O. Bastian, G. Calvert and J. H. Sanders. July 22nd. (Complete.)

16,745. "Improvements in wall cabinets for electrical apparatus." E. R. le Manquais. July 22nd. (Complete.)

16,763. "Improvements in and relating to electric heating apparatus." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) July 22nd.

16,766. "Improvements in and relating to electric arc lamps." J. H. Kaesen and L. J. Scheidel. July 22nd. (Complete.)

16,778. "Improvements in printing telegraph receivers." J. E. Wright. July 22nd. (Complete.)

16,780. "Improved apparatus for magnetic separation of ore." Metallurgiska Patentaktiebolaget. (Date applied for under Patents Act, 1901, July 23th, 1906, being date of application in Sweden.) July 22nd. (Complete.)

16,781. "Improved method of regulating the electrical potential of a network supplied by a generator driven at very variable speeds and apparatus therefor." O. Schaller. (Date applied for under Patents Act, 1901, August 11th, 1906, being date of application in Germany.) July 22nd. (Complete.)

16,799. "Improved accumulator." C. H. Montgomery. July 23rd.

16,813. "Improvements in electric switches." A. Eckstein and A. C. Heap. July 23rd.

16,837. "Electric automatic weigher." H. A. Danne. July 23rd.

16,847. "Improvements in electrical therapeutic apparatus for giving high-frequency currents." Marconi's Wireless Telegraph Co., Ltd., and F. C. Prentice. July 23rd.

16,854. "Improvements in and relating to telephonic apparatus." V. Tar Dieu. (Date applied for under Patents Act, 1901, January 12th, 1907, being date of application in France.) July 23rd. (Complete.)

16,862. "Improved means for automatically operating gas or other valves or electric switches at predetermined times." A. Hare. July 23rd. (Complete.)

16,910. "Improvements in non-arcing fuse devices." A. H. Mayes. July 24th.

16,911. "Improvements in or relating to electric ignition apparatus for internal combustion engines." The Electric Ignition Co., Ltd., and F. H. Hall. July 24th.

16,912. "Improvements in or relating to magneto-electric ignition apparatus for internal combustion engines." The Electric Ignition Co., Ltd., and F. H. Hall. July 24th.

16,942. "Electric current generating and motive power machine." W. S. Frost. July 24th.

16,952. "Improvements in or relating to electric welding." O. Kjellberg. July 24th. (Complete.)

16,956. "Improvements in and connected with arc lamps." H. E. Angold and The Maxim Electrical Co., Ltd. July 24th.

16,968. "Improved electrical resistance device for use with lamps and for other purposes." H. S. Martin. July 24th.

16,974. "Improvements relating to direct-current electric motors." Societe Anonyme Westinghouse and R. Brun. (Date applied for under Patents Act, 1901, July 26th, 1906, being date of application in France.) July 24th. (Complete.)

16,984. "Improvements in magnetic clutches." H. Leitner. July 24th.

16,985. "Improved sparking-plug." L. C. Bryan. July 24th.

17,012. "Improvements in wall plugs and sockets for use in electric lighting, heating, and power circuits." H. Bevis and A. J. D. Krause. July 25th.

17,015. "Improved portable electrically driven machine for grinding, and other purposes." F. Marshall, F. Crookes and G. Robson. July 25th.

17,046. "Improvements in and relating to the application of electricity for stimulating vegetable growth." J. E. Newman and L. Lodge. July 25th.

17,058. "Improvements in and relating to electric arc lamps." E. R. Grote and M. V. Ely, trading as Foster & Co. July 25th.

17,059. "Improvements in and relating to electric arc lamps." E. R. Grote and M. V. Ely, trading as Foster & Co. July 25th.

17,060. "Improvements in and relating to electric arc lamps." E. R. Grote and M. V. Ely, trading as Foster & Co. July 25th.

17,066. "Improvements in or relating to holders or fittings for electric incandescent lamps." A. Loebl and The British Ever-Ready Electrical Co., Ltd. July 25th. (Complete.)

17,067. "Improvements in or relating to electric hand lamps." A. Loebl and The British Ever-Ready Electrical Co., Ltd. July 25th. (Complete.)

17,078. "Improvements in electric signals." A. C. Brown. July 25th.

17,079. "Improvements relating to electric instruments for medical use." J. Gschwend. July 25th. (Complete.)

17,097. "Improvements in and relating to switch mechanism for electrically-propelled vehicles." Allgemeine Elektricitats-Ges. July 26th. (Date applied for under Patents Act, 1901, July 26th, 1906, being date of application in Germany.) (Complete.)

17,100. "Improvements in or relating to electrical 'intermitters' or 'flashers' in use for advertising or other purposes." A. B. Mudie and A. B. Gregson. July 26th.

17,102. "Improvements in the production of electrodes for secondary batteries." J. Taylor and E. Hancock. July 26th.

17,127. "Improvements relating to electric air suction apparatus." W. G. Potter. July 26th.

17,145. "Electric time meter hour counter and electrically-driven clock." P. Good and W. H. Bell. July 26th.

17,147. "Improvements in or relating to electrically-operated fountains." A. D. Southam. (Date applied for under Patents Act, 1901, August 4th, 1906, being date of application in United States.) July 26th. (Complete.)

17,178. "Improvements in prepayment electricity meters." W. M. Mordey and G. C. Fricker. July 26th.

17,192. "Improvements in electric arc lamps." L. B. Wilson. July 27th.

17,193. "Improved electrolytic cell." H. S. Hatfield. July 27th.

17,195. "Improvements in or relating to magneto-electric machines." P. R. van Haga. July 27th.

17,245. "Improvements in and connected with conduits for electric wires." T. Brown, J. Rowell, jun., and R. H. Rowell. July 27th.

17,254. "Improvements in connection with portable electric massaging and like apparatus." N. B. Le Fevre. July 27th.

17,257. "Improvements relating to selective telegraphy or telephony." Siemens Bros. & Co., Ltd., and G. S. Grimston. July 27th.

17,258. "Improvements in casing for electric conductors in buildings or the like." L. Molle and J. Debedts. July 27th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1907.

Apparatus for Magnetic Separation of Ore. Metallurgiska Patentaktiebolaget 210. January 3rd. (Date applied for under International Convention, January 11th, 1906.)

Electrical Bell Ringing Apparatus. F. Fluckiger. 1,082. January 15th.

Process of Improving the Magnetic Qualities of a Magnetic Body. R. A. Hadfield. 2,377. January 30th. (Date applied for under International Convention, July 5th, 1906.)

Guards or Fenders for Electric Tramcars. K. Lhotta, T. Lhotta and E. Lhotta. 3,006. February 6th.

Compensating or Commutation Poles of Dynamo-Electric Machines. Felten and Guilleaume Lahmeyerwerke Akt.-Ges. 4,045. February 18th. (Date applied for under International Convention, February 17th, 1906.)